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STUDIES ON PRE-SCHOOL CHILDREN

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PREFACE

Malnutrition is undoubtedly the biggest public health problem in our country today. The economic condition of a vast majority of our population is so poor that they are in no position to afford even the least expensive balanced diets. A number of nutrition and diet surveys carried out among adult population groups in various parts of the country have confirmed the existence of widespread malnutrition among the poorer sections of our population. Children and women in the productive period appear to be the worst sufferers.

Though children between the ages of 1 and 5 years constitute nearly 15% of the total population of our country and from the nutritional standpoint constitute a vulnerable group, it is unfortunate that this group has largely been, until now, a neglected one. The real extent and nature of malnutrition among pre-school children, has, so far, not been clearly defined. Information regarding the dietary pattern and nutrient intake of pre-school children is very scanty, and for the planning of nutrition programmes aimed at improving the nutritional status of pre-school children, it is essential to have this basic information. In this report are presented the findings of carefully conducted diet and nutrition surveys carried out under the auspices of the Indian Council of Medical Research at six different centres of the country. As a result, information not only on the pattern of malnutrition among pre-school children, but also on the nutrient intake of children belonging to the poor income groups, among whom malnutrition is widespread, has now become available.

One of the most significant observations that has emerged from these studies relates to the aetiology of protien calorie malnutrition. It is now clear that in the current dietaries of pre-school children, the major bottleneck is not protein as believed hitherto, but calories, and that the widespread protein calorie malnutrition among such children is, to a considerable extent, conditioned by inadequate calorie intake. What these children are suffering from, is really a food gap rather than a protein gap. In practical terms, these observations imply the need for a reorientation in our thinking and approach to the problem of protein calorie malnutrition, calling for, as it does, removal of undue emphasis on protein. Studies undertaken recently at the National Institute of Nutrition have, in fact, confirmed that pre-school children, who received supplements which provided about 300 calories and 3 to 4 g. of protein a day showed a very satisfactory growth rate.

It has long been recognised that nutrition is but one of the several determinants of optimal health, though admittedly an important one. Improvement of environmental sanitation, control of infection and limitation of family size are other important constituents. For a satisfactory improvement in the overall health status of pre-school children, it is obvious that all these factors must receive adequate attention.

It is, therefore, necessary to institute a package programme which incorporates all these aspects. In view of the current high toddler mortality rate, and in view of the well-known long-term implications of early childhood malnutrition, it is obvious that the total care of pre-school children must be taken up on a priority basis.

Dr. S. G. Srikantia, Dr. N. Pralhad Rao, Dr. K. Vijayaraghavan and Mr. K. Visweswara Rao, have helped in the preparation of this report and their contribution is gratefully acknowledged.

C. GOPALAN.

1. INTRODUCTION

In the technologically developed countries, nutritional deficiency diseases have been largely eliminated. Unfortunately, in most developing countries, including our own, malnutrition continues to be a major public health problem. Frank nutritional deficiency diseases account for a considerable proportion of hospital admissions and in a much larger number, the underlying state of malnutrition modifies adversely the course of many non-nutritional diseases.

Infants and children upto the age of 5 years constitute as much as 15% of our total population, and from the nutrition standpoint, constitute a vulnerable group. The age specific mortality rate of children between 1 and 5 years in India in the year 1965 was as high as 15 per 1000 as against below 2 per 1000 in affluent countries. Toddler mortality is generally accepted as a reliable indicator of the nutritional status of pre-school children. The high figure in our country may, therefore, be taken as indicative of the widespread prevalence of malnutrition. In spite of this, pre-school children have been a largely neglected group. The urgent necessity to plan for the nutritional needs of pre-school children is thus obvious. A pre-requisite for this purpose is a thorough understanding of the dietary intakes and nutritional status of pre-school children living under varying community conditions in different parts of the country and to assess the nature and extent of their nutritional problems.

While there have been some sporadic surveys carried out to determine the nutritional status of young children in localised areas in the country, there has been so far, little data collected on a countrywide scale on which recommendations and programmes could be based. It is somewhat surprising that while during the last two decades, considerable information has accumulated regarding the clinical, biochemical, pathological and therapeutic aspects of malnutrition, information regarding the diet and nutrient intake of pre-school children, among whom malnutrition is most widespread, is indeed very limited. The only information available about children's diets was what was computed from data on family diets, using coefficients, where an adult man is considered as one consumption unit and other members of the family considered as fractions of this unit depending upon their age and sex. Such a calculation has a serious drawback, because this system assumes that distribution of food within a family occurs according to physiological needs. On many occasions, this is not necessarily so.

Keeping these facts in mind, the Indian Council of Medical Research constituted a working party in 1965 to go into the various aspects of nutritional problems of pre-school children in different parts of the country. The working party first met in October 1965 and formulated guidelines for conducting well organised and extensive field investigations directed specifically against pre-school children in different parts of the country. The objectives were : (1) to define the nature and magnitude of nutritional disorders in pre-school children belonging to the poor socio-economic groups, and (2) to assess the dietary pattern and nutrient intakes of such children.

2. GUIDELINES FOR THE SURVEY

It was recommended by the working party that : (a) for the purpose of this study, a child between the age of 1 to 5 years would be considered as a pre-school child. (b) Assessment of correct age is of crucial importance in the proper interpretation of anthropometric data. Since it has been recognised that in most rural areas under field conditions, this is not always easy, all efforts were to be made to arrive at the correct age by making use of all available conventional tools such as dentition, ages of the other siblings in the family, mother's pregnancy, local event calendar, birth or baptismal certificates and horoscopes.

(c) A well organised nutrition and diet survey would be carried out on properly selected samples of pre-school children in at least 5 or 6 representative regions of the country.

(d) The survey should provide factual information on the socio-economic status, feeding habits, actual dietary intakes, nutritional status and anthropometric measurements.

(e) Investigations comprising of haemoglobinometry and radiology of wrists of these children should be carried out on a sub-sample.

2.1. Centres of study

Taking into account the need for covering as many regions in the country as possible, and also the practical considerations of availability of adequate facilities, the working party recommended the following six centres for carrying out the survey.

2.1.1. Nutrition Research Laboratories (now National Institute of Nutrition), Hyderabad.

2.1.2. Department of Preventive and Social Medicine, S.G.S. Medical College, Bombay.

2.1.3 Department of Paediatrics, All-India Institute of Medical Sciences, New Delhi.

2.1.4. Department of Paediatrics, Christian Medical College, Vellore.

2.1.5. Department of Nutrition, All India Institute of Hygiene and Public Health, Calcutta ; Department of Haematology, School of Tropical Medicine, Calcutta.

2.1.6. Department of Paediatrics, B.J. Medical College, Poona.

2.2. Investigations

Investigations included collection of data on the following important aspects :

2.2.1. Socio-economic conditions

2.2.2. Nutritional status :

(a) anthropometry

(b) clinical assessment

(c) haemoglobinometry

(d) radiological examination of the wrist joint

Children with haemoglobin levels below 8 gms. were taken up for more intensive studies, which included estimations of serum vitamin B_{12} and folic acid.

2.2.3. Quantitative assessment of diet intakes of children using the oral questionnaire technique.

2.3. Sample size

2.3.1. **Nutrition survey and anthropometry** : A minimum of 3000 children between the ages of 1 and 5 years were selected in each of the selected areas for purposes of diet and nutrition survey.

2.3.2. **Haemoglobin :** For the purpose of assessing the prevalence of anaemia, haemoglobin levels were determined in a sub-sample of 1000 children (constituted by every third willing child in the total of 3000 children). However examination of stool samples for the presence of parasitic ova, was not done.

2.3.3. **Radiological investigations :** To determine the incidence of rickets, every third willing child aged between 1 and 3 years from the selected sample was taken up for radiological investigations of the wrist and hand.

2.3.4. **Dietary intake :** Studies on dietary intake were conducted on 300 children, which constituted 10% of the total sample.

2.4. Sampling procedure

In order to obtain a proper representative sample, following procedure was used with due regard to practical and statistical considerations.

2.4.1. **Rural sample :** The rural sample was selected from the rural area, either a community development block with a population of 50,000 to 60,000 or some other area with the same population representative of the region.

A list of all the villages in the selected area with the population figures for each village was obtained. The villages were then classified as belonging to one of two categories :

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Category 1 : Population below 1000

Category 2 : Population of 1000 and above

The classification was considered to be necessary to obtain as representative a sample as possible, since it may be assumed with reason that villages with larger population might be better developed than those with small population, which might influence food availability and nutritional status.

From the total population of these two categories of villages, the approximate pre-school child population (between 1 and 5 years) in each category was obtained, on the assumption based on the all-India estimate that 12 to 15% of the total population is constituted by this age group. The sample of 3000 children was then drawn from the two categories of villages in the ratio of their child population. Assuming that there would be about 150 children in a village with population of more than 1000, the approximate number of villages to be selected in this category was obtained by dividing the allotted sample size by 150. Similarly, the number of smaller villages to be covered was calculated on the assumption that each such village would have about 50 pre-school children. The villages in the two categories were selected by random sampling using random numbers.

The number of children covered in each village was obtained by dividing the total sample allotted for each category on the basis of the proportion of child population in the selected villages.

2.4.2. Urban sample : The urban sample was selected from one or more municipal wards, with a population of about 50,000 to 60,000. Care was taken to ensure that the population in the selected locality was fairly homogeneous with regard to socio-economic status and living conditions.

All the families in this selected locality were enumerated and information on the number of families having pre-school children was collected. The number of children in each pre-school age group in the locality was also obtained. The required number of families to provide enough number of children in each age group were selected by random sampling technique. Where a complete enumeration of families was not possible, a systematic sampling of every third household was done covering every street, starting from one end of the locality along a certain planned route.

2.5. Methodology

Preparation of proforma and standardisation of survey techniques :

A standard proforma prepared and pre-tested by the National Institute of Nutrition, Hyderabad, based on the suggestions of the WHO Expert Committee on Medical Assessment of Nutritional Status (1963) was used. Similarly, a pre-tested proforma to collect information on dietary pattern was also used.

To ensure uniformity and comparability of data collected at the various centres by different teams, the investigators actually concerned with the collection of data

from all the centres, received training at the National Institute of Nutrition, Hyderabad, so as to minimise the inter-personal errors between the workers in the diagnosis of clinical signs, in taking anthropometric measurements, in estimating haemoglobin levels and in the interpretation of X-ray findings.

The protocol for diet and nutrition surveys, standard methods of anthropometry and haemoglobinometry (by Cyanmet haemoglobin method) agreed upon by the working party are given in annexures I, II III and IV.

3. RESULTS OF THE SURVEY

3.1. Sample covered

The details of the population characteristics and the actual sample covered in each region are given in Table-1. The sample covered at two centres - Bombay and Calcutta was drawn from urban localities of these two cities, while the sample studied at Hyderabad, New Delhi and Poona were rural samples drawn from the villages surrounding the cities. The sample studied at Vellore was a mixed one—roughly one half of the total sample coming from urban and semi-urban areas while the other half came from rural areas.

The age and sex distribution of the sample in each of the regions is presented in Tables-2 and 3. In each region, an almost equal number of boys and girls were covered in each age group.

3.2. Socio-economic conditions

3.2.1. Occupation : In rural areas the major occupation of the people studied was agriculture, a large proportion being landless labourers. A small proportion of families was engaged in non-agricultural avocations like shopkeeping, weaving, mat-making and other services.

3.2.2. Housing : The majority of people surveyed lived in either single or double-roomed, thatched or tiled huts, a small portion of which was usually set apart for cooking. Water supply was mainly from wells scattered around the villages. The villages lacked sanitary facilities and the environmental and personal hygiene were far from satisfactory.

Except in Calcutta, where a third of the sample came from the lower middle income group (Table-4), in all the other regions, more than 85% of the children belonged to low socio-economic group, with an income of below Rs. 40/- per caput per month. Nearly 54% of the children investigated, belonged to families with incomes less than Rs. 20/- per caput per month and must, therefore, be considered as coming from the poorest sections of the population. About 14% of children studied came from families with a monthly per caput income of Rs. 40/- or more (Table—4). Thus, the communities studied could be considered as belonging to the poor socio-economic strata.

3.2.3. General food habits : In general, the diets of the people were simple and more or less uniform. They usually consumed two or three meals per day, the bulk of which consisted of large amounts of a cereal and small amounts of a pulse. Rice was the staple in Calcutta and Vellore, while a combination of rice and sorghum or sorghum alone formed the staple of rural Hyderabad. In rural Poona, sorghum and wheat constituted the main cereals, with rice also being occasionally used. In Delhi, wheat and maize formed the staple. In areas where sorghum, wheat and maize were the

Table 1

SURVEY OF PRE-SCHOOL CHILDREN--AREA AND COVERAGE

Centre	Place	Type of sample	Total population	Income group	Total number of children examined
1. **BOMBAY** Department of Social and Preventive Medicine, Seth G.S. Medical College	Koli-wada Worli	Urban	50,000	Low and middle	3037
2. **CALCUTTA** The School of Tropical Medicine	Municipal Wards 40 and 49	Urban	25,000	Low and middle	3102
3. **HYDERABAD** The National Institute of Nutrition	C. D. Block Pattanchervu	Rural	66,000	Low	3115
4. **NEW DELHI** Department of Pediatrics, All India Institute of Medical Sciences	C. D. Block Ballabgarh	Rural	75,000	Low	3029
5. **POONA** Department of Pediatrics, Sasson Medical College	Villages around Poona	Rural	62,000	Low	3073
6. **VELLORE** Department of Pediatrics, Christian Medical College	Vellore town	Semi-urban	1,20,000	Low	3000
				Total :	18,356

staple, they were eaten in the form of 'roti" (unleavened bread). When rice was the staple, it was consumed along with a thin gruel prepared from the pulse cooked without vegetables. Consumption of fresh vegetables and flesh foods was irregular and in small quantities when consumed. Similarly, milk and milk products were rarely consumed by most of the people, primarily due to economic reasons. The use of spices like chillies, tamarind and other spices was more frequently seen in Calcutta, Poona, Hyderabad and Vellore than in Bombay and Delhi.

Table 2

COVERAGE OF CHILDREN ACCORDING TO REGION AND SEX

	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All Regions
Boys	1548	1588	1559	1644	1605	1523	9467
Girls	1489	1514	1556	1385	1468	1477	8889
Total	3037	3102	3115	3029	3073	3000	18356

The amount of oil included in the diet was very small. Groundnut oil was the most popular cooking oil in all the areas surveyed except in Calcutta, where mustard oil formed the common cooking medium.

The general food habits observed in these areas depended upon the local pattern of production of cereals, pulses, vegetable and milk.

Table 4

PERCENTAGE OF CHILDREN SURVEYED ACCORDING TO ECONOMIC STATUS

Economic group	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All regions
Per-caput income							
Rupees per month							
Less than 20	51.9	36·5	77.8	30.2	58.6	70.3	54.2
21—39	37.1	25.8	17.8	54.1	26.2	28.6	31.6
40 and above	11.0	37.7	4.4	15.7	15.2	1.1	14.2

3.2.4. Child Feeding Practices :

3.2 4.1. Breast feeding : In general, prolonged breast feeding was the rule in all the regions. Between the ages of 1 and 2 years, more rural children than urban children were found to live exclusively on breast milk. Rural Poona had the highest percent of entirely breast-fed children (84.4%) followed by Hyderabad (54.0%) and New Delhi (27.1%). With respect to children, who were receiving breast milk (in addition to supplements) even at as late an age as 4 and 5 years, considerable regional variations were observed. In Bombay, about 33% of children were still breast-fed at the age of 4 to 5 years, while in Hyderabad about 10% of children received breast milk at these ages. In other regions, around 1 to 3% of children belonged to this category (Table-5).

Table 3

POPULATION SURVEYED BY AGE AND SEX

Age group in years	Sex	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All regions
1—1½	Male	278 } 530	194 } 341	241 } 468	243 } 450	190 } 376	198 } 415	1344 } 2580
	Female	252 }	147 }	277 }	207 }	186 }	186 }	1236 }
1½—2	Male	221 } 412	135 } 305	168 } 327	185 } 353	172 } 340	179 } 370	1060 } 2107
	Female	191 }	170 }	159 }	168 }	168 }	191 }	1047 }
2—2½	Male	253 } 519	149 } 289	204 } 396	204 } 376	225 } 420	192 } 366	1227 } 2366
	Female	266 }	140 }	192 }	172 }	195 }	174 }	1139 }
2½—3	Male	130 } 232	172 } 344	174 } 363	150 } 284	171 } 315	173 } 357	976 } 1895
	Female	102 }	166 }	189 }	134 }	144 }	184 }	919 }
3—4	Male	288 } 605	297 } 577	388 } 770	361 } 677	325 } 631	401 } 769	2060 } 4029
	Female	317 }	280 }	382 }	316 }	306 }	368 }	1969 }
4—5	Male	378 } 739	635 } 1246	384 } 791	501 } 889	522 } 991	380 } 723	2800 } 5379
	Female	361 }	611 }	407 }	389 }	469 }	343 }	2579 }
1—5	Male	1548 } 3037	1588 } 3102	1559 } 3115	1644 } 3029	1605 } 3073	1523 } 3000	9467 } 18356
	Female	1489 }	1514 }	1556 }	1385 }	1468 }	1477 }	8889 }

Table 5

PERCENTAGE OF PRE-SCHOOL CHILDREN IN EACH REGION BY AGE ACCORDING TO THEIR FEEDING HABITS

Feeding habit	Region	Age in years						
		1–1½	1½–2	2–2½	2½–3	3–4	4–5	All ages (1–5)
Breastfed only	Bombay	1.3	0.5	0.2	—	—	—	0.2
	Calcutta	9.5	0.3	—	—	—	—	1.2
	Hyderabad	39.7	14.3	2.8	—	—	—	7.1
	New Delhi	24.1	2.3	1.3	—	—	—	3.6
	Poona	68.6	15.8	3.0	1.1	—	—	11.1
	Vellore	—	0.2	—	—	—	—	0.0
Breastmilk and supplements	Bombay	97.7	91.8	83.0	15.7	43.4	33.3	55.2
	Calcutta	81.1	70.2	39.4	22.9	8.5	1.6	29.2
	Hyderabad	58.5	76.8	64.5	52.3	28.7	10.0	41.1
	New Delhi	70.8	81.0	48.9	17.3	5.5	2.0	29.1
	Poona	28.1	55.7	17.8	5.4	0.5	0.5	13.6
	Vellore	79.9	55.5	40.7	21.1	9.1	2.9	27.7
Fully weaned	Bombay	1.0	7.7	16.8	84.3	56.6	66.7	44.6
	Calcutta	9.4	29.5	60.6	77.1	91.5	98.4	69.6
	Hyderabad	1.8	8.9	32.8	48.1	71.4	90.0	51.8
	New Delhi	4.4	16.7	49.8	82.5	94.5	98.0	67.3
	Poona	3.3	28.5	79.3	94.4	99.6	99.5	75.3
	Vellore	20.1	44.3	59.3	78.9	90.9	97.1	72.3

3.2.4.2. Weaning practices : Supplementary feeds were delayed in all the regions surveyed. In the regions of Bombay, Calcutta, Vellore and New Delhi, more than 70% of children received their supplements between the ages of 1 and $1\frac{1}{2}$ years while the majority of children in Hyderabad and Poona regions received supplements late during the second year of life (Table-5). The children were usually weaned after the age of 2 years. Pregnancy of the mother was found to be the main reason for stopping breast-feeding. About 50% of the children between the ages of 2 and 3 years were weaned off the breast and this increased to more than 80% in the age group of 4—5 years.

In general buffalo milk and/or cereal products like cooked rice, jowar/wheat roti or "dalia", formed the main staple fed regularly to the children. Availability in the house as well as adherence to tradition and customs were found to determine the choice of these foods as supplements. It was observed that some of the older children consumed small amounts of locally prepared snacks and biscuits bought from the local shops.

4. CLINICAL NUTRITION STATUS

The age-wise percentage prevalence of the various nutritional deficiency signs among the children are given in Tables 6 to 9 according to regions.

Table 6a

PERCENT PREVALENCE OF KWASHIORKOR AND MARASMUS

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All Regions
Kwashiorkor							
1—1½	0.0	0.0	0.4	0.4	1.2	0.7	0.5
1½—2	0.2	0.3	0.6	0.5	2.6	0.5	0.6
2—2½	0.6	0.0	1.3	0.2	2.5	0.8	0.9
2½—3	0.9	0.7	0.6	0.0	3.8	0.0	1.0
3—4	0.8	0.0	0.5	1.3	1.8	0.8	0.9
4—5	0.4	0.1	0.1	1.2	0.7	0.0	0.4
Marasmus							
1—1½	0.0	5.3	2.6	5.0	9.6	1.4	4.0
1½—2	0.0	4.7	1.5	4.0	6.9	3.0	3.4
2—2½	0.0	3.4	1.5	0.8	5.0	1.4	2.0
2½—3	0.0	1.8	0.8	1.4	1.8	2.2	1.3
3—4	0.0	0.5	0.4	1.0	1.8	1.2	0.8
4—5	0.0	0.2	0.0	0.1	0.8	0.3	0.2

The deficiency signs commonly observed among children in all the six areas were protein-calorie malnutrition, ocular manifestations of vitamin A deficiency and oral lesions due to deficiency of B-complex vitamins. Scurvy and rickets were seen only occasionally. In Bombay, however, there was a high incidence of bleeding gums, while in Poona and Calcutta, signs suggestive of active and/or healed rickets were more frequently observed.

4.1. Protein calorie malnutrition (PCM)

4.1.1. Kwashiorkor : The percentage prevalence of frank cases of kwashiorkor for all age groups as judged by the presence of clinical oedema was about 1.0%. The peak prevalence, however, was between 2 and 3 years, except in Delhi and Bombay, where the peak was observed between 3 and 4 years (Figure 1).

4.1.2. Marasmus : Overall prevalence of clinical marasmus as judged by muscle wasting was of the order of 2%. The peak prevalence was observed between 1 and 1½ years in almost all the regions (Figure 2).

Table 6b

PERCENT PREVALENCE OF ASSOCIATED DEFICIENCY SIGNS OF PROTEIN CALORIE MALNUTRITION : MOON FACE AND SKIN CHANGES

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All Regions
Moon Face							
1—1½	0.2	0.5	1.9	0.4	3.9	1.4	1.4
1½—2	0.7	0.0	2.8	0.3	6.6	3.8	2.4
2—2½	1.2	0.0	4.8	0.8	7.9	5.5	3.4
2½—3	0.9	0.5	6.3	0.0	12.1	7.6	4.9
3—4	0.8	0.1	6.4	0.6	6.8	6.1	3.5
4—5	0.3	0.1	3.3	0.2	3.0	3.6	1.8
Crazy pavement dermatosis							
1—1½	0.2	0.0	0.0	0.2	0.5	0.0	0.2
1½—2	0.0	0.0	0.0	0.3	0.8	0.0	0.4
2—2½	0.2	0.0	0.0	0.3	1.8	0.0	0.4
2½—3	0.0	0.0	0.0	0.0	2.1	0.0	0.4
3—4	0.8	0.0	0.0	0.3	0.9	0.0	0.3
4-5	0.5	0.0	0.0	0.0	0.3	0.0	0.1

Poona (5.5%) and Calcutta (4.3%) had relatively high incidence of frank kwashiorkor and marasmus, while Hyderabad (1.5%) and Bombay (0.5%) had low incidence, with New Delhi (2.5%) and Vellore (1.9%) having intermediate figures. The relative percentage prevalence of the various signs related to protein calorie malnutrition like oedema, marasmus, moon-face and hair changes are presented in Figure 3.

From the figures of prevalence of marasmus in various centres as well as the mean calorie intake of children in these centres, it would appear as though there is no direct relationship between the two. This apparent discrepancy may, however, be due to the following two reasons : the diagnosis of marasmus on clinical criteria is, to a certain extent, subjective and individual variations between investigators, in spite of using standardised techniques, might have led to differences in the prevalence rates. In addition, skewness in the distribution of calorie intake of children may have also partly contributed.

The relatively high prevalence of associated signs of PCM, like moon face, dyspigmentation of hair, sparseness and easy pluckability up to the age of 3 years and a marked fall after the age of 4 years, seem to indicate their usefulness in the clinical assessment of protein calorie nutritional status in a community. Of these, the peak age incidence of moon face appeared to coincide with that of oedema.

Table 6c

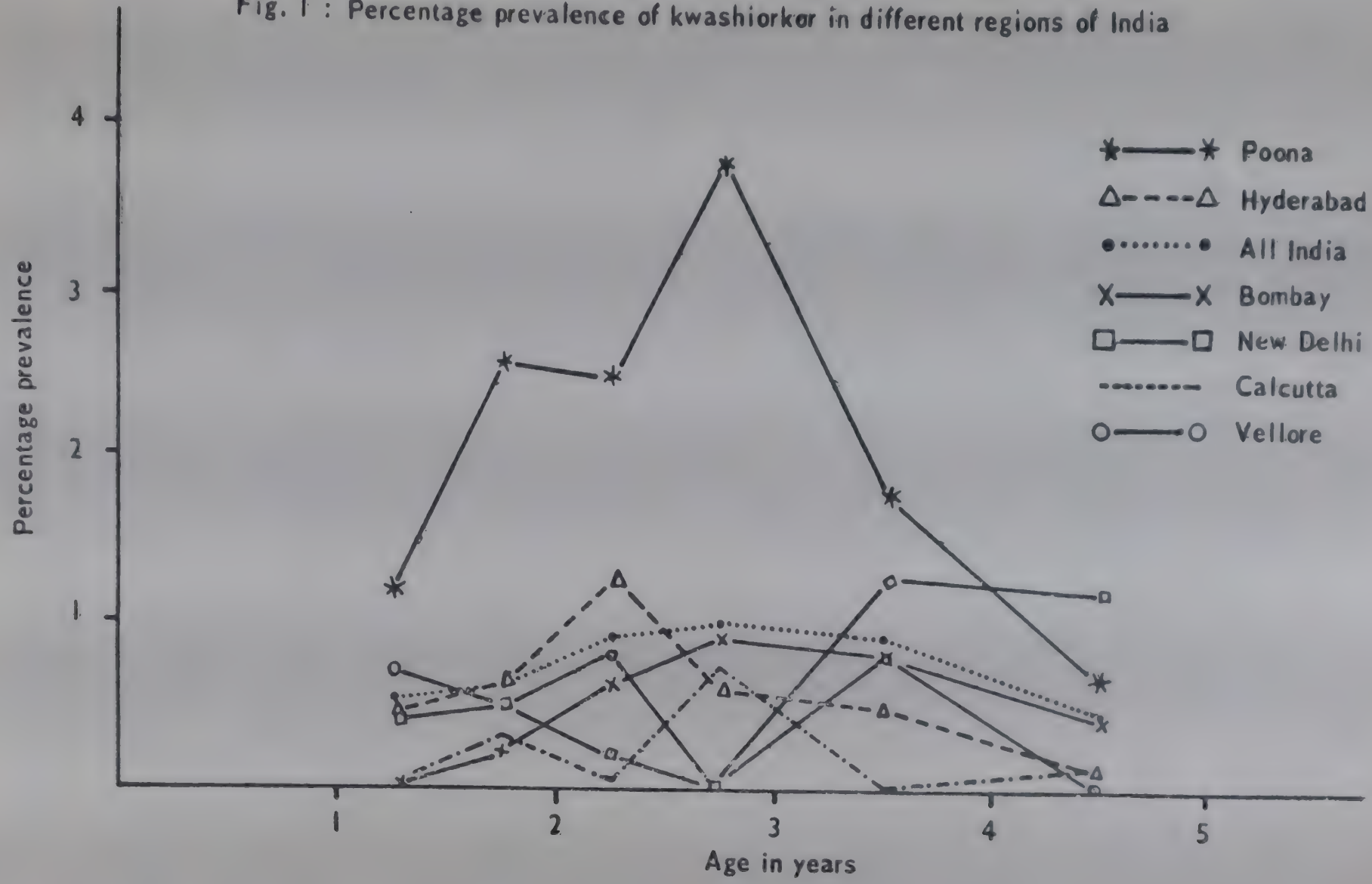
PERCENT PREVALENCE OF ASSOCIATED DEFICIENCY SIGNS OF PROTEIN CALORIE MALNUTRITION : HAIR CHANGES

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All Regions
Sparseness							
1—1½	10.8	4.4	8.3	1.3	3.3	1.0	6.3
1½—2	8.5	3.9	7.3	0.6	4.3	1.9	4.4
2—2½	10.0	3.8	3.0	0.8	3.6	0.3	3.6
2½—3	25.3	2.6	4.3	1.0	2.0	0.6	6.1
3—4	12.9	0.4	1.8	0.9	1.4	0.1	2.9
4—5	6.1	0.3	1.1	0.9	0.3	0.1	1.5
Discolouration							
1—1½	0.4	4.9	4.3	3.6	4.2	17.1	5.8
1½—2	0.5	3.8	11.3	2.0	7.2	17.0	7.0
2—2½	0.8	3.7	9.1	2.4	6.6	16.7	6.6
2½—3	2.2	4.1	8.3	0.7	5.4	19.0	6.6
3—4	0.5	1.3	5.8	0.5	2.8	11.8	3.8
4—5	0.9	0.8	3.5	0.2	1.7	8.3	2.6
Easy pluckability							
1—1½	—	1.5	1.3	11.6	2.0	1.7	3.0
1½—2	—	0.0	1.8	7.6	3.8	4.1	2.9
2—2½	—	0.3	0.8	3.2	4.1	1.4	1.6
2½—3	—	0.0	1.7	2.1	1.9	1.7	1.2
3—4	—	0.0	0.9	1.3	1.7	2.1	1.0
4—5	—	0.0	0.3	0.1	0.8	1.5	0.5

4.2. Vitamin A deficiency

Ocular manifestations of vitamin A deficiency like conjunctival xerosis and Bitot's spots were frequently encountered among the children. The overall prevalence of conjunctival xerosis and Bitot's spots were 4.2% and 2.9% respectively for all the regions taken as a whole (Table-7). There was five-fold rise in the prevalence of conjunctival xerosis with increasing age from 1.3% among children between 1-1½ years to 5.8% in children between 4-5 years of age. A similar trend was observed with respect to Bitot's spots (Figure 4). A total of eighteen cases of keratomalacia were seen in Vellore, Poona and Delhi regions. On the basis of the incidence of Bitot's spots and keratomalacia, it appeared that vitamin A deficiency was more prevalent in Hyderabad (5%) and Poona (4.6%) than in the other regions Bombay (2%), Calcutta (1.7%) and Delhi (1.2%).

Fig. 1 : Percentage prevalence of kwashiorkor in different regions of India



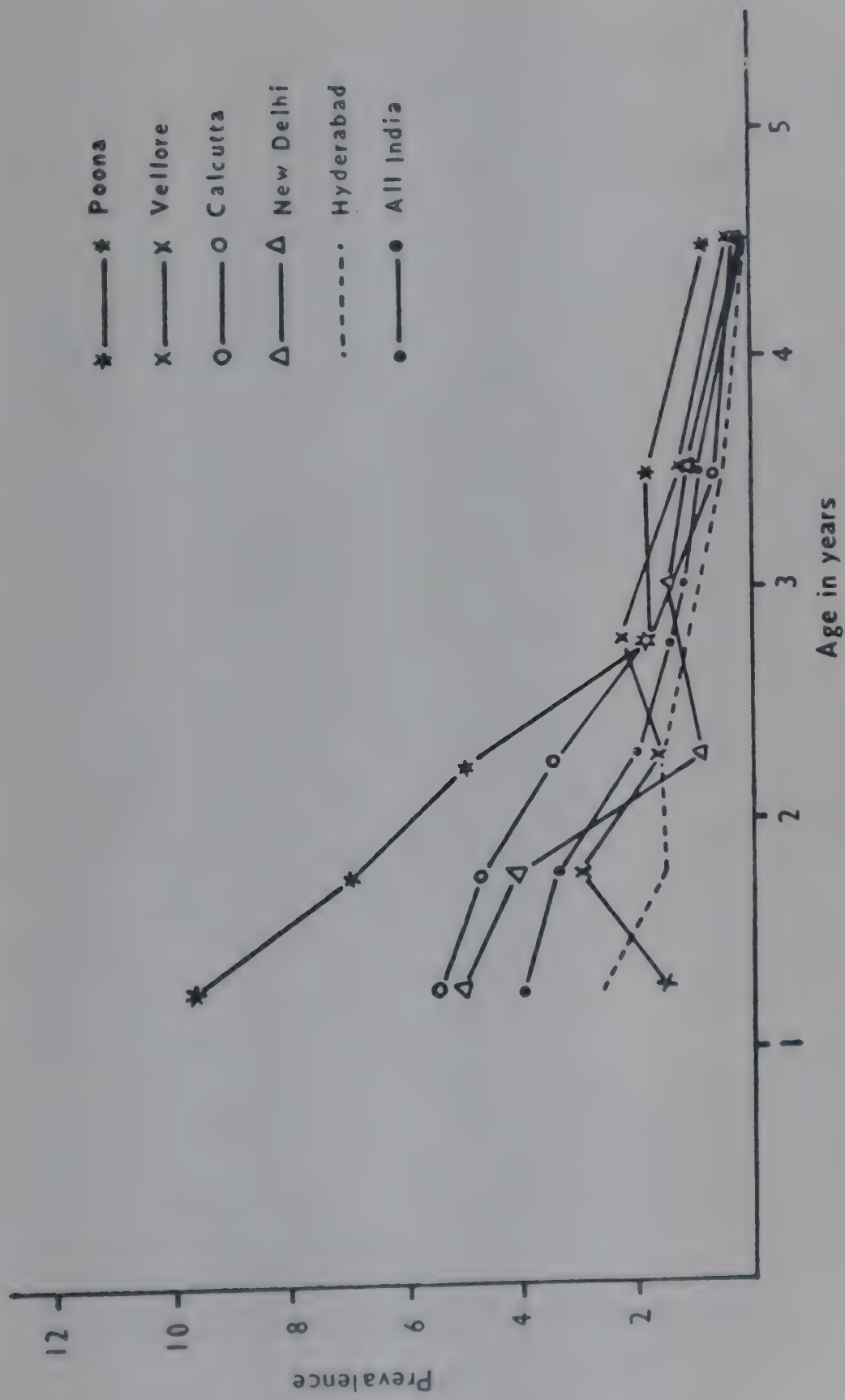


Fig. 2 : Percentage prevalence of marasmus in different regions of India

Fig.3 : Percentage prevalence of deficiency signs of Protein-Calorie Malnutrition – All regions

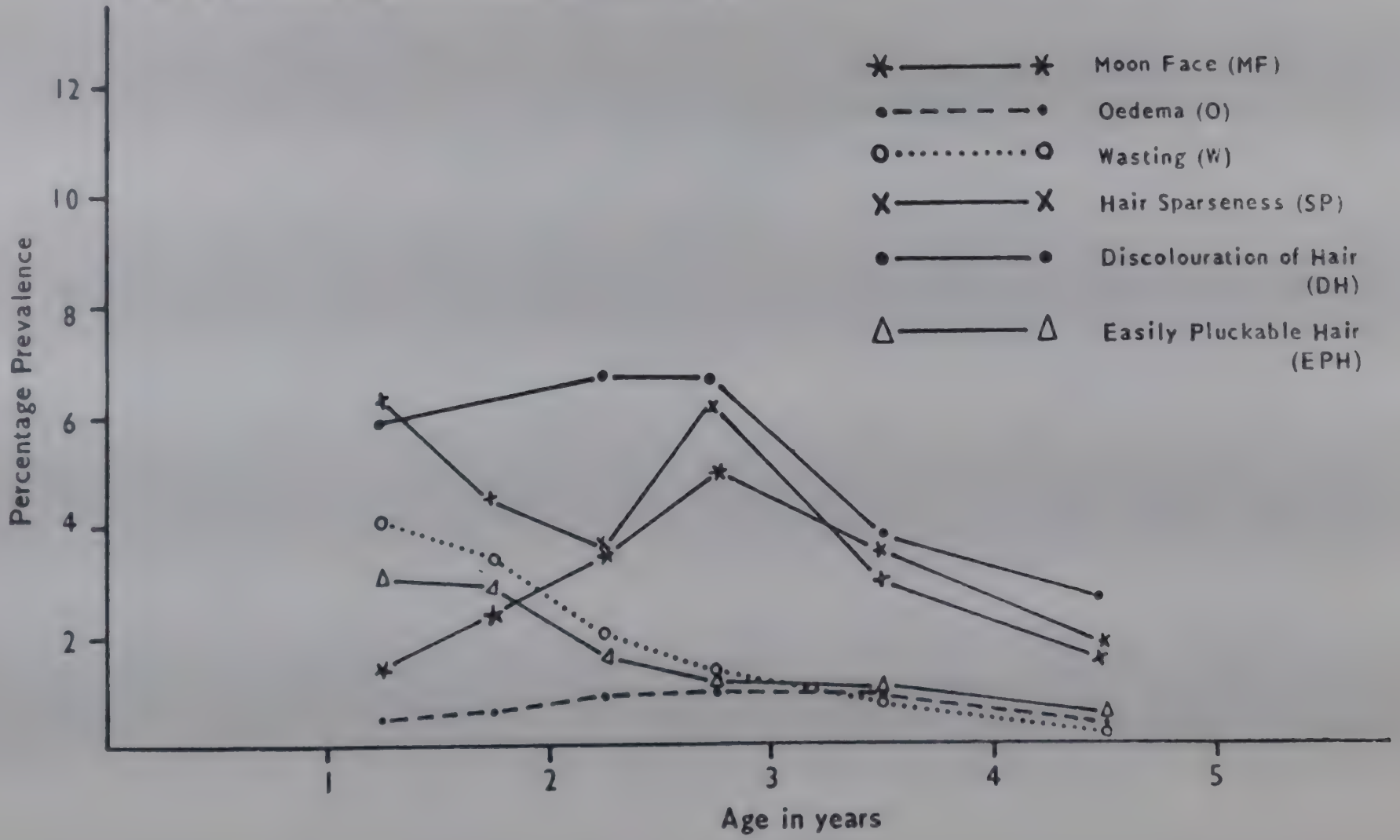


Table 7

PERCENT PREVALENCE OF VITAMIN A DEFICIENCY SIGNS

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All Regions
Conjunctival xerosis							
1—1½	0.0	0.5	2.6	0.9	3.8	0.2	1.3
1½—2	2.7	0.2	4.0	1.1	4.9	0.5	2.2
2—2½	1.3	1.0	4.3	1.6	13.0	0.0	3.5
2½—3	3.0	0.2	4.7	1.0	15.3	0.8	4.2
3—4	0.7	0.8	10.4	2.6	17.3	1.0	5.5
4—5	0.3	2.7	13.3	1.7	15.5	1·1	5.8
Bitot's spots							
1—1½	1.9	0.0	0.2	0.4	1.0	0.2	0·6
1½—2	6.3	0.2	0.6	0.0	0.8	0.8	1.5
2—2½	1.2	0.6	3.3	0.5	2.3	3·4	1.9
2½—3	3.4	0.2	4.4	1.0	4.3	5.3	3.1
3—4	0.8	0.5	4.2	1.0	6.4	7.2	3.3
4—5	0·9	1.4	10.8	1.9	6.5	7.1	4.8
Corneal xerosis & Keratomalacia							
1—1½	0.0	0.0	0.0	0.4	0.0	0.0	0.1
1½—2	0.0	0.0	0.0	0.2	0.0	0.5	0.1
2—2½	0.0	0.0	0.0	0.0	0.7	0·0	0.1
2½—3	0.0	0.0	0.3	0·0	0.3	0.3	0.2
3—4	0.0	0.0	0.0	0.1	0.3	0.0	0.1
4—5	0·0	0.0	0.0	0.2	0.5	0.1	0.1

4.3. Vitamin B-complex deficiency

Angular stomatitis was the major deficiency sign of the B-complex vitamin group (Table-8). In general, there was an increase in its prevalence with increasing age from 1.6% in the age group 1-2 years to 7.5% in the age group of 4-5 years with an average percentage prevalence of 5.2 for the entire pre-school population (Figure 5). Glossitis and cheilosis were the other oral lesions which were present in 0.5 to 0.7% of the number surveyed (Table-8). Signs of B-complex deficiency were seen most frequently in Vellore (14%) followed by Hyderabad (7.6%), Poona (3.3%), Calcutta, Bombay (2.1%) and New Delhi (1.6%).

The incidence of Bitot's spots and angular stomatitis tended to be higher among boys than among girls, while the incidence of the severe forms of PCM tended to be higher among girls.

Fig. 4 : Percentage prevalence of vitamin-A and vitamin B-Complex deficiency signs by age – All Regions

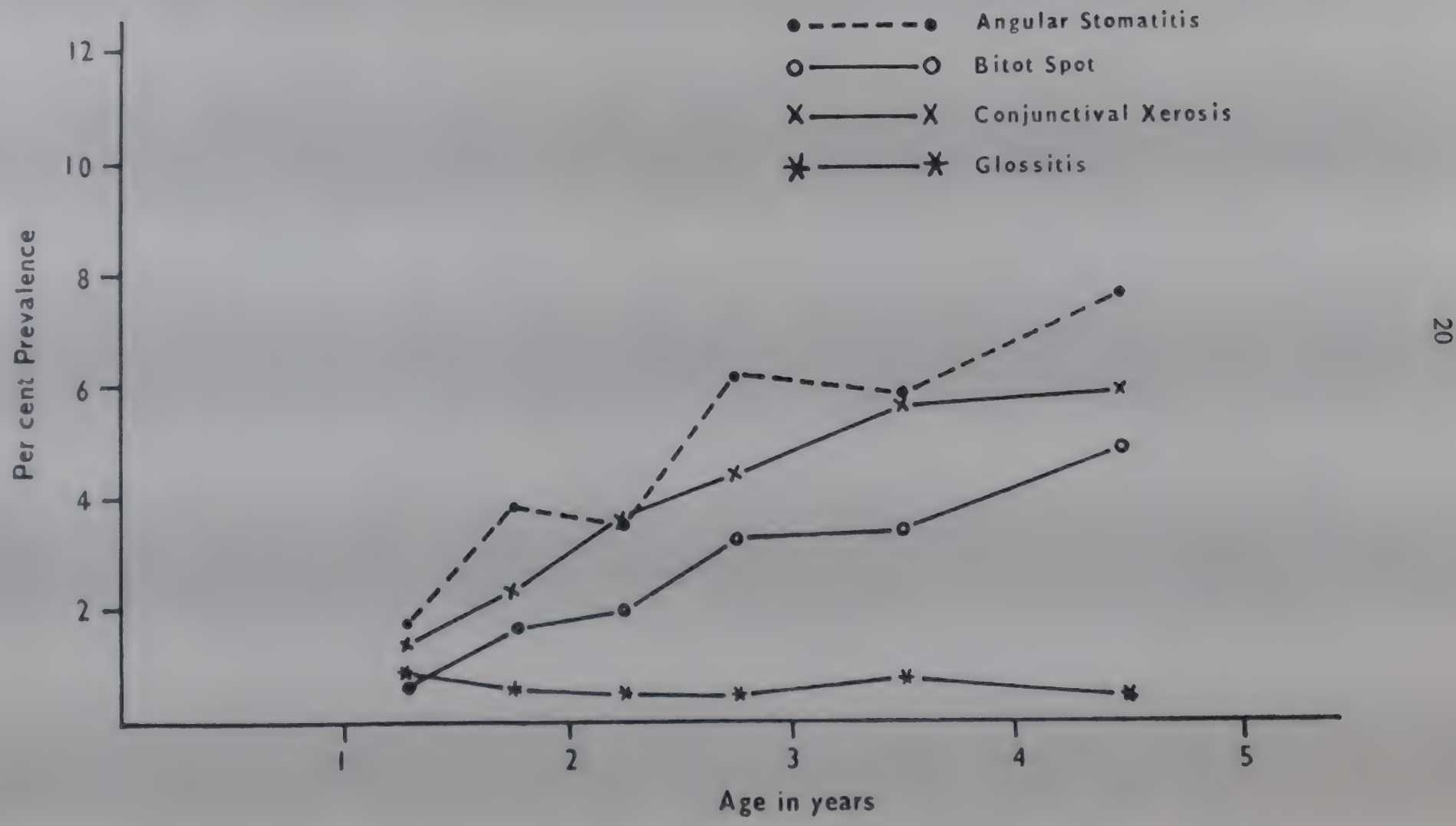


Table 8

PERCENT PREVALENCE OF VITAMIN B COMPLEX DEFICIENCY SIGNS

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All Regions
Angular stomatitis							
1—1½	1·3	1.5	1.9	0.4	2.0	3.6	1.6
1½—2	2.4	2.2	4.0	1.1	4.3	8.9	3.8
2—2½	5.0	4.2	3.8	1.3	3.4	12.8	3.4
2½—3	4.7	3.9	4.7	2.5	4.3	16.2	6.1
3—4	0.7	3.0	8.1	2.2	3.8	16.4	5.7
4—5	0.9	3.6	15.2	1.7	2.6	20.7	7.5
Glossitis							
1—1½	0.2	0.0	1.1	1.5	0.0	0.2	0.8
1½—2	0.5	0.0	0.6	1.4	0.0	0.3	0.5
2—2½	0.2	0.3	0.0	0.8	0.9	0.0	0.4
2½—3	0.0	0.8	0.3	0.3	0.0	1.1	0.4
3—4	1.2	1.6	0.1	0.4	0.0	0.8	0.7
4—5	0.4	1.2	0.0	0.2	0.1	0.7	0.4
Cheilosis							
1—1½	0.0	0.5	0.2	0.7	1.0	0.0	0.4
1½—2	0.0	2.2	0.0	0.5	1.1	0.0	0.6
2—2½	1.7	4.2	0.0	0.0	1.1	0.0	1.2
2½—3	2.2	3.9	0.0	0.7	2.2	0.0	1.5
3—4	0.3	3.0	0.3	0.6	0.6	0.0	0.8
4—5	0.8	3.6	0.5	0.0	0.9	0.1	1.0

4.4. Other deficiency signs

Clinical signs suggestive of active and healed rickets such as epiphyseal enlargement, Harrison's sulcus, Fronto-parietal bossing and pigeon-chest were infrequently seen, except in Vellore and Poona, where 0.9 and 1.8% of children exhibited these manifestations (Table-9a). The overall prevalence in all the regions combined was low being around 0.6% of the children surveyed. Signs of ascorbic acid deficiency were negligible in all the regions. In Bombay, however, a high prevalence of bleeding gums was observed (Table-9b). In the absence of other signs of ascorbic acid deficiency and in the presence of bad oral hygiene its relevance to ascorbic acid deficiency appears little.

Folicular hyperkeratosis was seen in 1.5% of the total children surveyed (Table-9c). The prevalence was four-fold higher in the older age group of 3-5 years

as compared to younger children below 3 years, in all the regions. Children from Calcutta and Vellore exhibited the highest prevalence of this deficiency sign.

The average percentage prevalence of dental caries was 6.7 (Table–9b). The prevalence increased with age. Urban children seemed to suffer more than rural children; the prevalence was high in Bombay (19.1%) and Calcutta (9.0%) in comparison to rural regions of Hyderabad (1.0%) and New Delhi (0.8%).

Table 9a

PERCENT PREVALENCE OF OTHER DEFICIENCY SIGNS

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All Regions
Craniotabes							
1—3	0.2	0.0	0.0	0.0	0.0	0.0	0.03
3—5	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Beading of ribs							
1—3	0.3	0.0	0.0	0.1	1.2	0.8	0.40
3—5	0.0	0.0	0.0	0.5	0.4	0.2	0.20
Epiphyseal enlargement							
1—3	0.6	1.4	0.0	0.5	4.7	0.5	1.30
3—5	1.1	0.4	0.1	0.2	3.5	0.1	0.90
Harrison sulcus							
1—3	0.1	0.2	0.5	0.0	3.0	4.8	0.93
3—5	0.0	0.0	0.5	0.0	1.6	0.2	0.47
Frontal and parietal bossing							
1—3	0.2	1.4	0.0	0.4	5.0	6.4	2.23
3—5	0.1	0.5	0.1	0.1	2.3	1.7	0.80
Pigeon-chest							
1—3	0.0	0.1	0.1	0.0	1.5	0.0	0.30
3—5	0.0	0.1	1.0	0.0	1.0	0.1	0.37
Knock-knee							
1—3	0.0	0.1	0.0	0.0	0.2	0.1	0.07
3—5	0.2	0.5	0.0	0.0	0.2	0.2	0.20

4.5. Anaemia

Estimation of haemoglobin was done in 6062 pre-school children drawn systematically from the total sample. The age and sex distribution of the sample is set out in Table-10. Mean levels of haemoglobin and Packed Cell Volume (PCV) are given in Tables 11 and 13. The average haemoglobin level for the whole group was 10.4 g/100ml. Based on the criterion of the WHO Study Group on iron deficiency anaemia (1959), 62.8% of children between the ages of 1 to 3 years and 44% of children between 3 and

5 years (Table-12) could be considered as suffering from anaemia, since they had haemoglobin levels below 10.8 g. per cent. Severe and moderate anaemia with haemoglobin levels less than 7.8 g. per cent was present in about 12% of all children. The prevalence of anaemia decreased with increasing age. Moderate and severe degrees of anaemia were more frequently seen in younger children below 3 years of age. The highest incidence of anaemia was in Delhi, followed by Bombay, Poona, Hyderabad, Vellore and Calcutta in that order (Table–12).

Table 9b

PERCENT PREVALENCE OF OTHER DEFICIENCY SIGNS

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All regions
Spongy bleeding gums							
1—1½	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1½—2	0.0	0.0	0.0	0.0	0.0	0.3	0.1
2—2½	1.8	0.0	0.8	0.5	0.2	1.1	0.8
2½—3	6.8	0.0	0.0	0.0	0.0	0.3	1.2
3—4	20.4	0.3	0.0	0.0	0.1	0.4	3.5
4—5	10.6	0.1	0.0	1.3	0.1	0.4	2.1
Caries teeth							
1—1½	0.0	0.2	0.0	0.0	0.0	0.0	0.0
1½—2	0.0	0.8	0.3	0.3	1.1	2.0	0.5
2—2½	2.4	2.3	0.0	0.3	4.3	2.5	2.0
2½—3	10.5	2.7	0.3	1.0	7.9	2.0	4.1
3—4	30.8	10.8	1.4	1.2	9.8	5.2	9.9
4—5	39.1	22.0	2.2	1.0	11.8	5.7	13.6

Packed cell volume was estimated in only three of the centres. The mean value was 33.1%, there being no differences with age (Table-13).

Since stool examinations were not carried out in this study, ne extent to which ankylostome infestation could have contributed to the low haemoglobin levels observed in these children is difficult to assess.

4.6. Rickets

The results of radiological examination of wrists are given in Table-14. These studies were carried out in only two centres–Hyderabad and Poona. Only one female child aged 1½ years showed evidence of active rickets in the Hyderabad region, while 6.5% of children of 1 to 3 years examined in Poona region showed radiological evidence of rickets. About 30 and 19 per cent of the children respectively in the two areas showed signs of growth arrest.

Table 9c

PERCENT PREVALENCE OF OTHER DEFICIENCY SIGNS

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All regions
Phrynoderma							
1—3	0.5	1.4	0.0	0.4	0.2	1.3	0.6
3—5	1.5	4.3	0.1	1.3	1.7	6.1	2.5
Pigmentation of knuckles							
1—3	0.0	0.0	0.0	—	0.0	0.1	0.02
3—5	0.0	0.0	0.0	—	0.0	0.4	0.1

Table 10

POPULATION COVERED FOR HAEMOGLOBIN SURVEY

Age in years	Sex	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All regions
1—2	Male	232	99	142	145	132	117	867
	Female	102	100	121	134	122	136	715
2—3	Male	134	111	123	127	145	125	765
	Female	92	96	121	106	130	115	660
3—4	Male	108	94	130	111	106	140	689
	Female	68	77	126	126	89	123	603
4—5	Male	124	224	137	153	157	123	918
	Female	118	201	147	113	145	121	845
1—5	Male	598	528	532	536	540	505	3239
	Female	380	474	515	473	486	495	2823
Total	Male + Female	978	1002	1047	1009	1026	1000	6062

Table 11

MEAN HAEMOGLOBIN LEVELS OF PRE-SCHOOL CHILDREN SURVEYED IN DIFFERENT REGIONS OF INDIA

Age :Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All Regions
1—2	10.0	10.6	9.9	8.7	9.4	10.4	9.8
2—3	10.4	11.1	9.9	8.8	9.8	10.6	10.1
3—4	10.7	11.5	10.1	8.6	10.8	11.2	10.5
4—5	11.3	11.9	11.1	9.7	11.3	11.6	11.2
1—5	10.6	11.3	10.3	9.0	10.3	11.0	10.4

Table 12

PERCENTAGE DISTRIBUTION OF CHILDREN BY AGE AND HAEMOGLOBIN LEVELS

Region	Bombay		Calcutta		Hyderabad		New Delhi		Poona		Vellore		All regions	
Age in years	1–3	3–5	1–3	3–5	1–3	3–5	1–3	3–5	1–3	3–5	1–3	3–5	1–3	3–5
Hb levels (g/100 ml)														
Below 4.8	0.0	0.0	0.2	0.0	3.3	5.2	0.8	1.6	1.4	0.8	0.0	0.2	1.9	1.3
4.9 — 7.7	5.2	5.0	5.2	1.7	11.0	10.2	35.2	23.1	11.7	9.3	6.0	3.0	1.24	8.7
7.1 — 10.7	65.4	45.0	33.5	18.4	46.2	25.7	47.0	49.3	66.1	35.4	48.3	30.3	49.4	34.0
Above 10.8	29.4	50.0	61.1	79.9	39.2	58.9	17.0	26.0	30.8	54.5	45.4	66.4	37.2	56.0

Table 13

MEAN VALUES OF PACKED-CELL VOLUME OF PRE-SCHOOL CHILDREN SURVEYED IN DIFFERENT REGIONS OF INDIA

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All regions
1—2	27.3	—	33.5	—	—	33.5	31.1
2—3	32.2	—	33.3	—	—	33.6	33.0
3—4	32.9	—	33.0	—	—	35.5	33.8
4—5	33.2	—	33.4	—	—	35.6	34.1
1—5	31.3	—	33.3	—	—	34.7	33.1

Total 14

RADIOLOGY OF WRIST : PERCENT PREVALENCE OF RICKETS AND TRANSVERSE LINES OF GROWTH ARREST IN PRE-SCHOOL CHILDREN OF RURAL HYDERABAD AND POONA

					Percentage prevalence of		
		Numbers examined			Rickets	Transverse lines	
Age : Years	Sex	Hyderabad	Poona	Hyderabad	Poona	Hyderabad	Poona
1—2	Male	28	21	—	4.8	35.7	9.5
	Female	39	19	2.6	10.5	23.1	31.6
2—3	Male	33	54	—	1.9	33.3	24.1
	Femole	37	47	—	8.5	32.4	10.6
1—3	Male	61	75	—	3.4	34.4	16.8
	Female	76	66	1.3	9.5	27.6	21.1
Total	Male+ Female	137	141	0.7	6.5	31.0	19.0

5. DIETARY INTAKE

The mean intakes of food items of children in the different age groups in different regions are presented in Tables 15a to 15d. The recommended amounts in the balanced diet suggested by the Indian Council of Medical Research in 1968 for each food item, are also included.

The diets of children in all the regions studied were predominantly cereal-based and the amounts of cereal consumed varied between 57 g and 204 g depending on age. The intake of protein-rich foods like legumes and fiesh foods was considerably low in all the regions. Similarly, consumption of milk was low in all areas, except in Calcutta where the intakes were marginally adequate with reference to recommended allowances. Consumption of sugar/jaggery was highest in Delhi area as compared to other areas, but even here, fell short of the recommended allowance. The habit of offering seasonal fruits to young children was seen only in two regions-Bombay and Vellore, though the quantity offered was small. Dietary intakes of children between the ages of 1 and 2 appeared to be particularly low in all the regions. This was due to the usual practice of prolonged breast feeding of children which invariably delayed supplementation with other foods. It was also due to the widely held belief among mothers of the low socio-economic group, that as long as the child was on the breast, there was no need for any supplementary foods to be given.

Table 15a

FOOD INTAKE OF PRE-SCHOOL CHILDREN OF AGE 1—2 YEARS IN DIFFERENT REGIONS IN INDIA

Region	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All regions	Recommended allowances : g/day	
								Vegetarian	Non-vegetarian
Food items : g/day									
Cereals	53.3	46.9	45.0	103.5	37.0	58.7	57.4	150.0	150.0
Pulses	5.7	8.4	2.0	5.5	5.1	8.1	5.8	50.0	40.0
Green leafy vegetables	2.0	10.2	0.2	4.0	0.0	2.7	3.8	50.0	50.0
Other vegetables	8.0	46.8	0.0	17.0	0.0	5.9	15.5	30.0	30.0
Milk	106.5	326.9	102.0	213.0	133.0	111.5	165.5	300.0	200.0
Flesh foods	1.3	48.6	0.2	0.0	2.1	1.7	10.8	—	30.0
Fruits	19.0	0.0	0.0	0.0	0.0	15.2	11.4	50.0	50.0
Sugar and jaggery	10.3	0.0	0.5	29.0	0.0	8.8	12.2	30.0	30.0
Oils and fats	1.0	6.1	0.2	4.0	1.4	1.7	2.4	20.0	20.0

Table 15b

FOOD INTAKE OF PRE SCHOOL CHILDREN OF AGE 2—3 YEARS IN DIFFERENT REGIONS IN INDIA

Region	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All regions	Recommended allowances : g/day	
Food items : g/day								Vegetarian	Non-vegetarian
Cereals	147.4	95.0	113.3	116.0	137.3	167.8	129.4	150.0	150.0
Pulses	11.3	11.4	13.3	5.0	10.6	12.7	10.7	50.0	40.0
Green leafy vegetables	2.5	11.3	3.0	7.5	0.0	3.9	5.6	50.0	50.0
Others vegetables	13.6	67.8	7.0	11.0	0.0	15.6	23.0	30.0	30.0
Milk	72.7	299.5	98.0	136.0	105.3	72.6	130.7	300.0	200.0
Flesh foods	5.3	60.9	1.5	0.0	2.1	5.5	15.1	—	30.0
Fruits	15.3	0.0	0.0	0.0	0·0	16.4	15.9	50.0	50.0
Sugar and jaggery	9.6	0.0	2.0	22.5	0.0	8.0	10.5	30.0	30.0
Oil and fats	2.0	8.1	4.0	3.0	6.1	2.0	4.2	20.0	20.0

Table 15c

FOOD INTAKE OF PRE-SCHOOL CHILDREN OF AGE 3—4 YEARS IN DIFFERENT REGIONS IN INDIA

Region	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All regions	Recommeeded allowances : g/day	
								Vegetarian	Non-vegetarian
Food items : g/day									
Cereals	199.6	102.8	165.0	186.5	177.4	214.5	174.3	200.0	200.0
Pulses	114.3	13.9	20.0	6.5	12.3	22.5	14.9	60.0	50.0
Green leafy vegetables	3.3	13.5	7.0	6.5	0.0	3.9	6.8	75.0	75.0
Other vegetables	20.8	81.6	17.0	20.5	0.0	19.4	31.9	50.0	50.0
Milk	49.3	268.7	62.0	190.5	79.7	34.1	114.1	250.0	200.0
Flesh foods	110.1	60.3	5.0	0.0	3.4	4.5	16.8	—	30.0
Fruits	11.8	0.0	0.0	0.0	0.0	7.6	9.7	50.0	50.0
Sugar and jaggery	4.6	0.0	2.5	24.5	0.0	3.9	8.9	40.0	40.0
Oils and fats	4.3	9.7	6.0	5.0	4.5	3.8	5.6	25.0	25.0

Table 15d

FOOD INTAKE OF PRE-SCHOOL CHILDRCN OF AGE 4—5 YEARS IN DIFFERENT REGIONS IN INDIA

Region	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All regions	Recommended allowances : g/day	
Food items : g/day								Vegetarian	Non vegetarian
Cereals	213.3	139.5	176.0	249.5	218.6	227.5	204.1	200.0	200.0
Pulses	15.0	19.5	20.0	10.0	13.6	15.5	15.6	60.0	50.0
Green leafy vegetables	4.6	13.9	9.0	6.0	0.0	2.8	7.3	75.0	75.0
Other vegetables	24.8	90.1	16.0	23.5	0.0	29.0	36.7	50.0	50.0
Milk	28.9	218.9	130.0	156.0	73.0	28.0	105.8	250.0	200.0
Flesh foods	19.9	54.9	5.0	0.0	4.6	5.7	16.4	—	30.0
Fruits	14.7	0.0	0.0	0.0	0.0	14.2	14.5	50.0	50.0
Sugar and jaggery	4.1	0.0	5.0	32.5	0.0	3.2	11.2	40.0	40.0
Oil and fats	4.3	10.5	6.0	5.5	8.2	3.4	6.3	25.0	25.0

6. NUTRIENT INTAKE

The nutrient content of the diets consumed by these children belonging to six different regions are presented in Tables 16a to 16d. The protein and calorie intakes both in absolute amounts and in terms of unit body weight have been indicated. The recommended allowances of these two nutrients made by the ICMR in 1968 have been shown alongside for purposes of comparison.

6.1. Calorie and protein intake

The daily intake of protein by children in the 1-5 year age group in all the six centres ranged between 18 g and 28.5 g/day in absolute amounts and from 1.7 to 2.8 g/kg body weight (Table-17). Most of the protein was derived from vegetable sources and even after making allowances for the poor biological quality of the dietary protein, the mean intake met the recommended allowances made by the ICMR (Table-18). The protein quality of these diets was also found to be satisfactory as judged by their NDP Cals %. The NDP Cals % of diets in all the areas was above 5.5 except in Bombay where it was 4.5. All these values are well above the value of 4, calculated on the basis of ICMR recommendations for proteins and calories, indicating that children who were consuming these diets in amounts sufficient to meet their calorie needs were meeting or more than meeting the recommended allowances for proteins (Figure 5).

The mean intake of calories per day in the six regions was 760, with a range of 558 to 946 calories, being highest in Delhi and lowest in Calcutta. On the basis of body weights, intake of calories ranged fram 54 C/kg in Calcutta to 89 C/kg in Delhi, with a mean of 74 C/kg for all the areas. These intakes found to be considerably below recommended allowances in terms of both absolute amounts and unit body weight.

Wide variations were found in the individual child's intakes, and the figures for the average intakes may, therefore, be somewhat misleading. The cumulative frequency (percentages) distribution of children by intake of protein and calories for the data obtained from Hyderabad region are presented in Figure 6. Such an analysis brings out the relative deficiencies of protein and calories in the dietaries of pre-school children. These data showed that on the basis of recommended allowances, while 92% of the children were deficient in calories, only 35% were dificient in proteins. They also indicated that in these 35% of children, if the food intake had been raised to meet their calorie requirements, the protein needs would have also been met. There was no situation where the child was adequate with regard to calories but deficient with regard to proteins. These data clearly showed that contrary to earlier belief, the primary bottleneck in the current dietaries of our pre-school children is their calorie content and not the protein content. They also suggest that the widespread prevalence of PCM among poor children is largely conditioned by the low calorie intake, since in such a

Table 16a

NUTRIENT INTAKE OF PRE-SCHOOL CHILDREN OF AGE 1-2 YEARS BY REGIONS IN INDIA

Regions	Bombay	Calcutta	Hyderabad	New Delhi	Pooha	Vellore	All regions	Recommended allowances (ICMR 1968)
Nutrients								
Calories	414	496	294	790	445	432	479	1200
Proteins	10.0	24.0	9.0	20.9	12.5	11.8	14.7	17.0
Vitamin A (I. U.)	406	630	201	807	333	389	461	1000
Iron (mg)	4.0	3.7	2.2	14.5	3.0	4.4	6.3	15-20
Calcium (mg)	152.0	409.0	189.4	527.0	325.1	231.8	305.7	450.0
Thiamine (mg)	0.22	0.41	0.19	0.43	0.22	0.22	0.28	0.60
Riboflavin (mg)	0.24	0.80	0.20	0.42	0.24	0.24	0.36	0.70
Niacin (mg)	2.33	1.80	1.69	4.07	1.79	2.71	2.40	8.00

Note : The above figures are exclusive of those obtained from breast milk. The contribution of breast milk to above nutrients are : Calories 278, Proteins 4.7 g, and vitamin A 297 I. U.

Table 16b

NUTRIENT INTAKE OF PRE-SCHOOL CHILDREN OF AGE 2-3 YEARS BY REGIONS IN INDIA

Regions	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All Regions	Recommended allowances (ICMR 1968)
Nutrients								
Calories	797	653	601	697	753	788	715	1200
Proteins (g)	16.7	29.8	16.9	26.8	21.0	20.0	21.9	18.0
Vitamin A (IU)	429	529	410	650	425	431	479	1000
Iron (mg)	8.5	8.4	6.1	15.5	9.1	10.1	9.6	15-20
Calcium (mg)	206.4	309.9	236.1	393.0	228.1	225.3	283.7	450
Thiamine (mg)	0.47	0.55	0.46	0.43	0.60	0.45	0.49	0.60
Riboflavin (mg)	0.35	0.80	0.35	0.34	0.36	0.37	0.43	0.70
Niacin (mg)	5.50	4.10	3.89	4.17	4.94	6.55	4.86	8.0

Note : The above figures are exclusive of those obtained from breast milk. The contribution of breast milk to above nutrients is: Calories 132, Proteins 2.2 g and Vitamin A 167 I. U.

Table 16c

NUTRIENT INTAKE OF PRE-SCHOOL CHILDREN OF AGE 3-4 YEARS BY REGIONS IN INDIA

Regions	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All Regions	Recommended allowances (ICMR 1968)
Nutrients								
Calories	911	828	796	1037	968	908	908	1200
Proteins (g)	20.9	38.0	21.8	32.4	24.6	23.6	26.9	20.0
Vitamin A (I.U.)	461	595	655	781	475	421	565	1200
Iron (mg)	10.2	12.1	9.2	24.5	11.5	12.8	13.4	15-20
Calcium (mg)	215.4	343.0	228.5	562.0	200.3	203.4	292.1	450.0
Thiamine (mg)	0.61	0.52	0.64	0.66	0.75	0.55	0.62	0.60
Riboflavin (mg)	0.422	1.20	0.44	0.50	0.39	0.41	0.56	0.70
Niacin (mg)	7.45	5.80	5.61	6.53	6.14	8.16	6.62	8.00

Note The above figures are exclusive of those of obtained from breast milk. The contributions of breast milk to above nutrients is : Calories 58, Proteins 0.9 g and Vitamin A 62 I.U.

Table 16d

NUTRIENT INTAKE OF PRE-SCHOOL CHILDREN OF AGE 4-5 YEARS BY REGIONS IN INDIA

Regions	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All regions	Recommended allowances (ICMR 1968)
Nutrients								
Calories	968	876	837	1259	1074	963	996	1500
Proteins (g)	236	34.8	22.7	39.8	29.2	23.3	28.9	22.0
Vitamin A (I.U.)	603	483	836	730	485	530	611	1200
Iron (mg)	12.3	15.3	9.9	31.0	13.9	13.6	16.4	15.20
Calcium (mg)	216.9	232.0	350.0	479.5	203.5	189.0	278.6	450.0
Thiamine (mg)	0.65	0.64	0.71	0.85	0.91	0.57	0.72	0.80
Riboflavin (mg)	0.42	0.81	0.54	0.55	0.45	0.40	0.53	0.80
Niacin (mg)	8.02	6.20	6.18	8.33	7.48	8.61	7.47	10.0

Note : The above figures are exclusive of those obtained from breast milk. The contribution of breast milk milk to above nutrients is : Calories 14, Proteins 0.2 g and Vitamin A 15 (I. U.)

Table 17

INTAKES OF CALORIES AND PROTEINS PER CHILD PER DAY IN DIFFERENT REGIONS OF INDIA 1-5 (YEARS)

Region	Total Calories	Total Proteins : g	Calories / kg body weight	Protein : g/kg body weight	NDp Cal%*
Bombay	773	17.9	72	1.7	4.5
Calcutta	588	24.0	54	2.2	8.8
Hyderabad	725	19.4	74	1.9	6.5
New Delhi	946	28.5	89	2.8	6.0
Poona	813	22.4	79	2.2	6.1
Vellore	764	19.4	78	2.0	5.5

$$*\text{NDp Cals\%} : \frac{\text{Calories from protein}}{\text{Total calories}} \times \text{NPU}$$

Table 18

RECOMMENDED ALLOWANCES FOR PROTEINS AND CALORIES*

Age : Years	Protein		Calories per day
	g / kg	g / day	
1	1.90	16.5	1200
2	1.72	18.5	1200
3	17.0	20.0	1200
4-6	1.66	22.0	1500

*ICMR, 1968

of providing energy. An appreciation of this fact is obviously of great practical importance in the formulation of public health measures of control and prevention of PCM.

6.2. Vitamin and Mineral intake

The average intakes of certain vitamins and minerals by the children are given in Table-19. Although the intakes of vitamins and minerals increased with increasing age, the overall position is far from satisfactory. The diets were found to be low in riboflavin, ascorbic acid, iron and calcium and grossly inadequate with respect to vitamin A. The extent of deficit of some of these nutrients is shown in Figure 7.

Fig. 5 : NDP Cal % of diets of preschool children compared with recommended allowances of ICMR (1968)

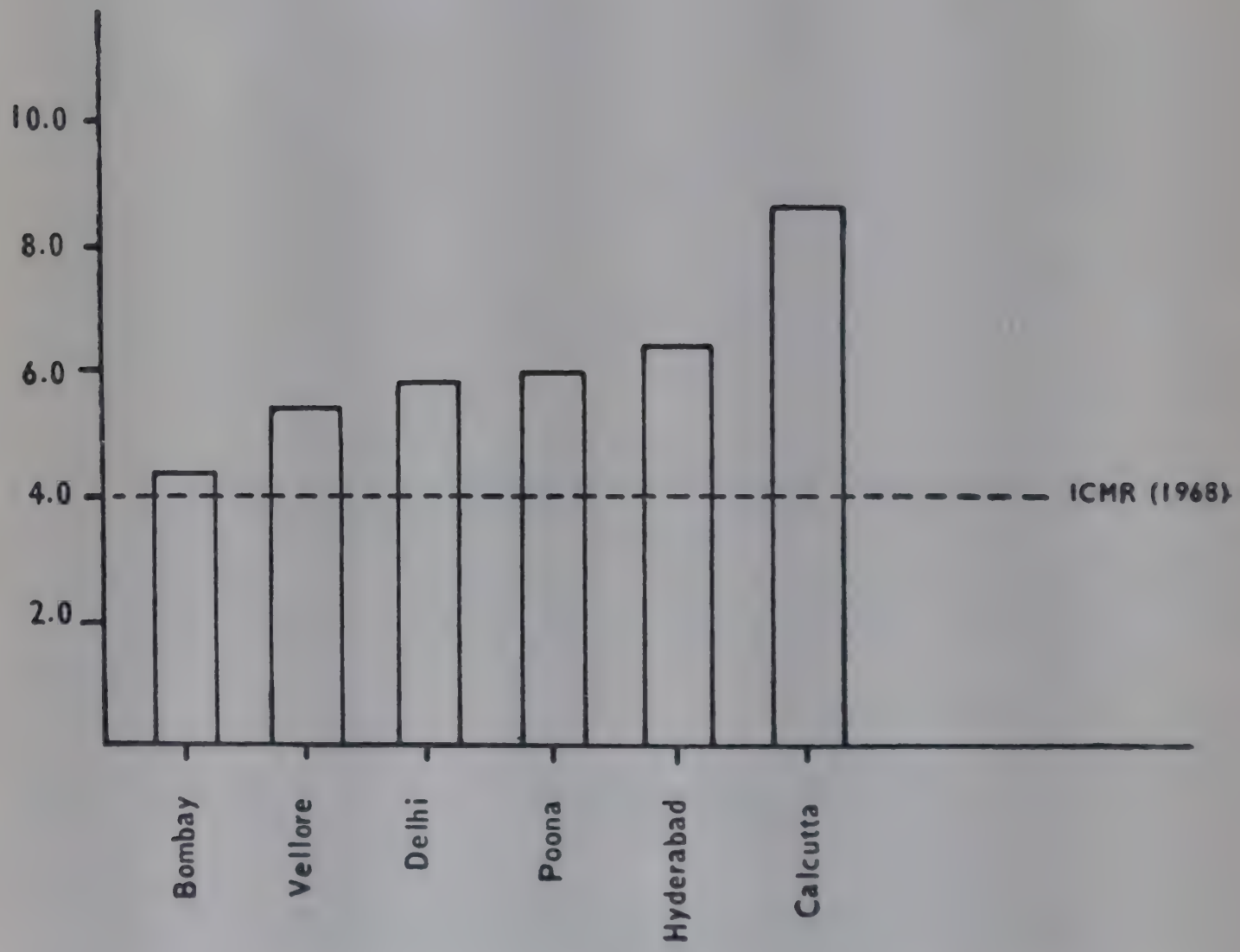


Fig. 6 : Cumulative frequency (percentage) distribution of preschool children (Hyderabad region) by intake of proteins and calories

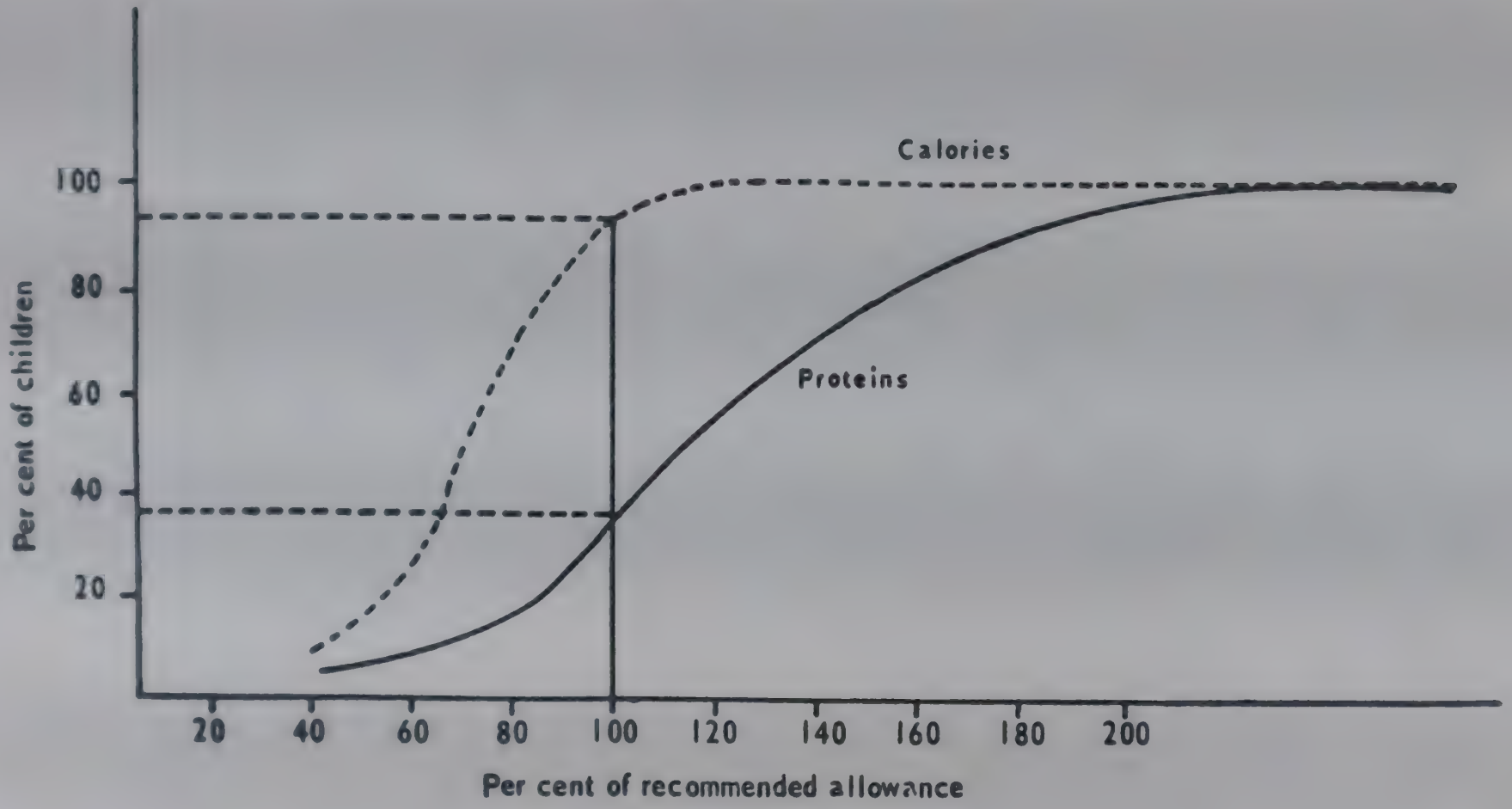


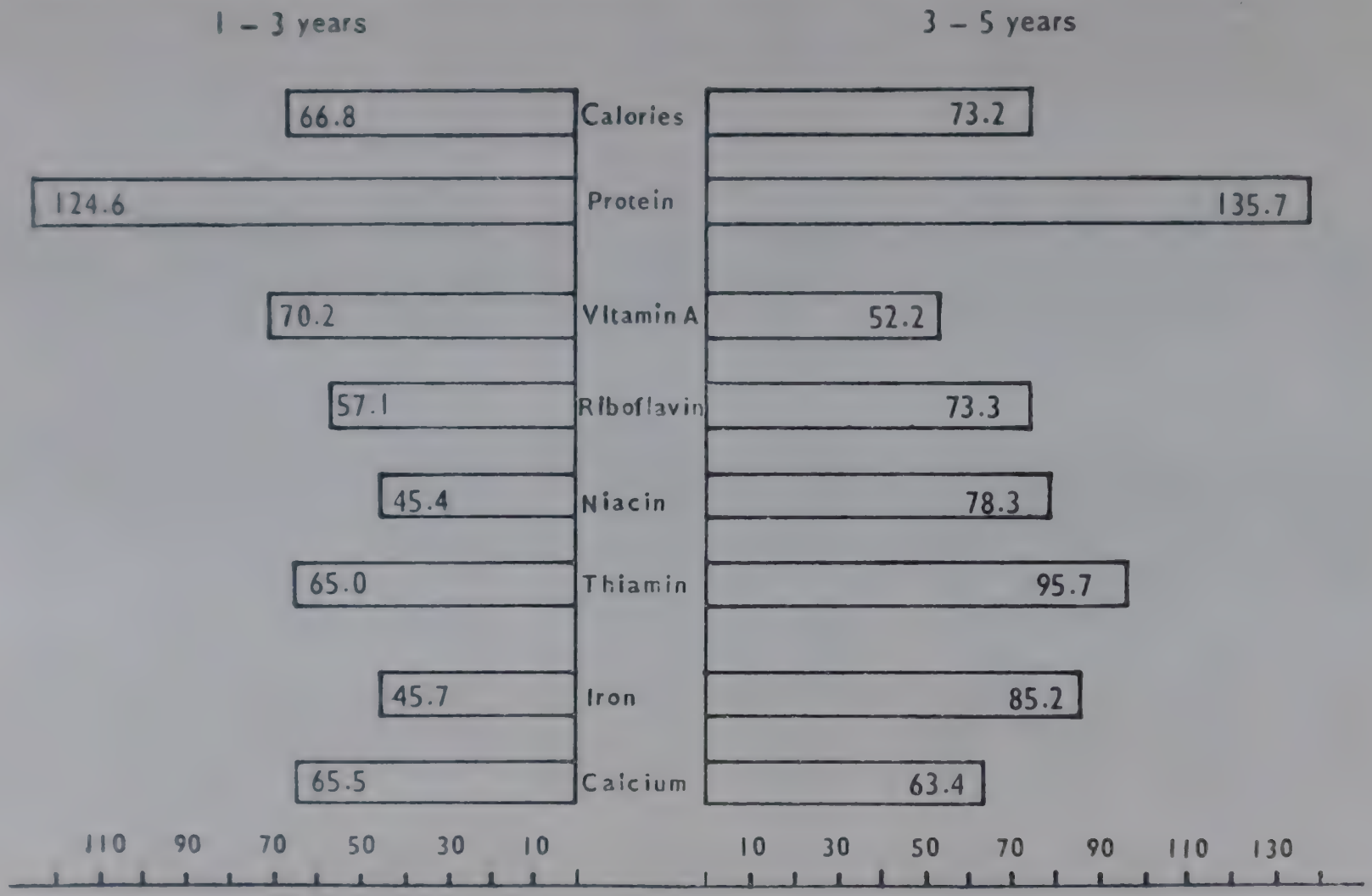
Table 19

VITAMIN AND MINERAL INTAKE OF PRE-SCHOOL CHILDREN*

Nutrient	Average intake	Recommended allowance ICMR (1968)
Thiamine ; mg/1000 cal	0.53	0.5
Riboflavin ; mg/1000 cal	0.30	0.55
Niacin Equivalents ; mg/1000 cal	9.90	6.6
Ascorbic acid ; mg/day	4.4	30–50
Vivamin A (Retinol) ; µg/day	61	250–300
Iron ; mg/day	5.9	15–20
Calcium ; mg/day	193	400–500

*Hyderabad region

Fig. 7 . Dietary intake of nutrients by preschool children as per cent of ICMR Recommended allowancee



7. ANTHROPOMETRIC MEASUREMENTS

The mean and standard deviations of all the anthropometric measurements taken - height, weight, arm circumference, head circumference, chest circumference calf circumference and skin fat fold thicknesses over calf and triceps are presented in Tables 20 to 27 for boys and girls separately. There was a remarkable closeness of values for all measurements in all the six regions. In the absence of similar data on children belonging to the high socio-economic groups, in whom there are no constraints on growth, it is difficult to interpret the data obtained here on rural children belonging to the poor income groups. The data obtained in this study have, therefore, been compared with standards reported for normal American children.

7.1. Heights

The mean height of children in the different areas was found to be 15 to 20% lower than that of the standard. Children with one or more signs of PCM, like moon face, hair dyspigmentation etc., had values lower than those without such signs.

7.2. Weight

The mean weight of children in the different areas was 40 to 50 per cent below that of American standard. Compared to deficit in height, deficit in weight was more marked.

7.3. Arm circumference

The mean values for arm circumference in the different regions were between 70 and 90% of the standard. In younger children upto the age of 3 years, about 15% of children had values below 60% of the standard. In contrast, in children above this age, less than 1% of children had values below 60% of the standard.

7.4. Head and Chest circumference

The mean head circumference was about 8 to 10% lower than the standard, while the chest circumference was about 15 to 17% lower. The chest circumference overtook the head circumference between 24 and 30 months of age. The event occurred slightly earlier in children at Bombay and Calcutta regions. In American children as well as in Indian children of the well-to-do groups, the chest circumference overtakes that of the head between 9 and 12 months of age. The data obtained here indicates, therefore, that there is a 12-18 month lag period in the development of the chest, in rural pre-school children belonging to the poor communities.

7.5. Calf circumference

Calf circumference increased with age, the increments being higher than those observed for arm circumference.

Table 20

ANTHROPOMETRIC MEASUREMENTS OF PRE-SCHOOL CHILDREN
HEIGHT : Cms (Mean ± S. D.)

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All regions
			Boys				
1 —1½	71.6±4.3	70.0±4.6	71.5±4.0	69.6±4.3	69.4±5.9	72.4±4.9	70.8
1½—2	72.3±4.2	74.5±5.6	75.0±3.0	73.5±4.9	72.9±6.6	77.0±4.5	74.2
2 —2½	79.7±5.3	78.1±5.1	76.8±8.6	77.2±5.5	77.6±5.8	80.0±5.2	78.2
2½—3	84.5±5.6	82.4±5.7	79.4±7.6	81.5±6.0	80.1±4.7	82.6±5.1	81.8
3 - 4	87.7±5.7	87.9±6.0	84.9±4.5	85.7±6.0	85.3±7.0	85.9±5.6	86.2
4—5	93.8±5.2	96.6±6.3	91.9±6.0	94.8±7.4	93.3±5.6	92.9±5.7	93.9
			Girls				
1 —1½	70.5±4.6	68.8±4.1	70.0±2.9	67.0±4.6	68.6±5.3	70.6±4.5	69.3
1½—2	73.1±4.4	73.7±5.4	73.4±3.7	72.1±5.3	72.1±6.0	75.1±4.7	73.3
2 —2½	79.2±5.1	77.4±5.3	76.1±3.9	75.1±5.1	75.5±3.3	78.7±5.2	77.1
2½—3	83.0±5.4	80.4±5.8	79.2±4.0	79.6±5.8	80.4±6.4	81.9±5.7	80.8
3—4	85.9±5.5	86.8±5.4	83.3±6.3	83.9±9.4	84.2±3.9	85.2±4.8	84.9
4—5	92.1±5.1	95.7±6.9	90.4±6.8	90.1±7.7	92.2±8.2	92.1±3.5	92.6

Table 21

ANTHROPOMETRIC MEASUREMENTS OF PRE-SCHOOL CHILDREN
WEIGHT : Kg (Mean±S. D.)

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All regions
			Boys				
1 —1½	8.1±1.2	8.0±1.4	7.7±1.3	7.8±1.4	7.6±0.7	7.6±1.1	7.8
1½—2	8.4±1.2	9.1±1.6	8.4±1.1	8.3±1.5	8.3±1.2	8.4±1.2	8.5
2 —2½	9.2±1.3	9.6±1.6	9.2±1.3	9.7±4.9	9.3±1.2	9.3±1.3	9.4
2½—3	8.8±1.6	10.6±1.6	9.6±1.5	10.4±1.9	9.9±1.6	9.7±1.4	9.8
3 —4	10.0±1.4	11.9±1.7	11.1±1.5	11.6±1.8	11.1±1.3	10.9±1.6	11.1
4 —5	13.5±1.5	13.7±2.0	12.6±1.6	13.7±1.8	12.7±1.7	12.5±1.8	13.2
			Girls				
1 —1½	7.6±1.1	7.6±1.4	7.2±1.3	6.7±1.4	7.4±0.9	7.1±1.0	7.3
1½–2	8.0±1.3	8.6±1.6	7.8±1.7	7.9±1.7	8.0±1.4	7.8±1.2	8.0
2 —2½	9.0±1.5	8.9±1.5	9.8±1.3	8.9±1.5	8.7±1.7	8.7±1.3	9.0
2½—3	9.7±1.3	10.0±1.2	9.3±1.4	10.0±1.5	9.8±1.6	9.5±1.4	9.7
3 —4	10.5±1.3	11.2±1.4	10.5±2.0	10.8+11.9	10.7±1.3	10.6±1.5	10.7
4 —5	12.5±1.5	13.3±1.8	12.1±1.4	13.1±1.9	12.4±2.5	12.2±1.8	12.6

Table 22

ANTHROPOMETRIC MEASUREMENTS OF PRE-SCHOOL CHILDREN
HEAD CIRCUMFERENCE : Cms (Mean ± S. D.)

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All regions
			Boys				
1 —1½	44.9±3.0	43.7±1.8	43.9±1.6	44.0±2.0	43.4±3.4	43.8±3.1	43.9
1½—2	46.0±3.1	44.9±1.4	44.9±3.6	45.3±1.9	44.4±2.4	44.9±3.3	45.1
2 —2½	45.0±3.1	45.5±1.8	45.3±3.5	46.1±2.2	45.1±2.0	45.8±3.1	45.5
2½—3	46.7±2.8	46.6±1.4	45.7±3.8	46.9±1.6	45.7±3.4	46.3±2.7	46.3
3 —4	48.5±2.7	47.0±1.7	46.8±1.0	47.6±1.7	46.5±1.7	46.9±2.9	47.2
4 —5	48.9±2.8	47.7±1.6	47.5±6.2	48.5±1.6	47.4±1.8	47.4±2.5	47.9
			Girls				
1 —1½	43.8±2.1	42.9±1.5	42.8±1.4	42.9±7.0	42.7±2.5	42.8±1.6	43.0
1½—2	44.8±2.2	43.9±1.6	43.7±3.8	44.1±1.8	43.7±1.8	43.7±2.4	44.0
2 —2½	45.2±3.2	44.6±1.6	44.5±1.4	44.7±1.8	44.2±4.8	44.4±3.0	44.6
2½—3	46.5±2.9	44.9±1.5	45.0±1.4	45.6±1.5	45.1±2.3	45.2±3.0	45.4
3 —4	46.7±2.9	45.9±1.5	45.7±1.6	46.1±1.7	46.1±2.1	45.9±2.9	46.1
4 —5	48.1±2.5	46.6±1.4	6.1±1.4	47.4±1.7	47.0±1.8	46.8±1.4	47.1

Table 23

ANTHROPOMETRIC MEASUREMENTS OF PRE-SCHOOL CHILDREN
CHEST CIRCUMFERENCE : Cms (Mean±S. D.)

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All Regions
			Boys				
1 —1½	45.2±2.2	43.9±2.6	41.8±2.3	42.2±2.8	42.9±2.5	42.8±2.1	43.1
1½—2	46.8±2.9	45.3±2.6	43.1±2.0	43.9±2.7	43.7±3.5	43.9±3.1	44.5
2 —2½	45.9±2.5	46.6±2.7	43.8±3.2	45.6±2.6	45.3±3.2	44.3±2.8	45.4
2½—3	47.8±2.3	47.8±2.7	44.8±2.5	46.8±2.7	46.1±4.3	46.0±2.1	46.6
3 —4	49.2±2.7	48.9±2.3	46.8±2.3	48.3±2.6	47.7±3.3	47.5±2.3	48.1
4 —5	50.4±3.0	50.5±2.4	48.4±4.3	50.0±2.2	49.3±2.5	48.8±3.0	49.6
			Girls				
1—1½	44.5±2.1	43.0±2.6	40.4±4.0	40.9±4.4	42.0±3.6	41.7±2.2	42.1
1½—2	45.9±2.7	44.2±2.4	42.0±2.3	42.6±2.5	43.0±3.1	42.9±2.3	43.4
2 —2½	45.8±2.4	45.3±2.6	43.1±2.3	43.1±2.3	43.8±4.3	44.1±2.6	44.4
2½—3	46.8±2.5	46.2±2.6	43.8±2.1	45.7±2.3	45.4±1.9	45.1±3.1	45.5
3 —4	48.1±2.4	47.7±2.6	45.3±2.8	47.0±2.8	46.6±2.1	46.7±2.3	46.9
4 —5	50.0±2.8	48.8±2.2	47.3±2.1	49.0±2.2	48.4±2.9	48.0±2.5	48.6

Table 24

ANTHROPOMETRIC MEASUREMENTS OF PRE-SCHOOL CHILDREN
ARM CIRCUMFERENCE : Cms (Mean ± S.D.)

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All Regions
			Boys				
1 —1½	13.2±1.0	12.3±1.5	12.4±1.0	12.1±1.4	12.5±1.6	12.2±1.0	12.5
1½— 2	13.9±1.0	13.0±1.5	12.5±1.1	12.4±1.4	12.4±1.5	12.2±1.4	12.7
2 —2½	13.5±1.1	13.3±1.4	12.9±1.7	12.8±1.2	12.9±1.7	12.4±1.1	13.0
2½—3	13.6±2.1	13.5±1.2	12.3±1.1	13.1±1.2	13.1±1.5	12.5±1.2	13.0
3 —4	14.2±1.5	13.3±1.0	12.6±1.4	13.6±1.2	13.6±1.4	13.0±3.1	13.4
4 —5	15.2±1.3	13.9±1.2	13.8±1.2	14.0±1.0	13.9±1.6	13.3±1.0	14.0
			Girls				
1 —1½	12.9±1.2	12.4±1.6	12.1±1.2	11.6±1.3	12.0±2.4	11.5±1.5	12.1
1½—2	13.5±1.1	12.6±1.3	12.3±1.3	12.2±1.4	12.5±1.8	11.9±1.9	12.5
2 —2½	14.6±1.5	12.8±1.6	12.5±1.3	12.6±1.2	12.7±1.0	11.8±3.4	12.8
2½—3	13.9±1.7	13.2±1.1	12.5±1.2	12.0±1.2	13.1±1.1	12.4±1.2	13.0
3 —4	14.0±1.2	13.5±1.1	13.3±1.2	13.2±1.3	13.4±2.1	12.9±1.1	13.4
4 —5	14.4±1.5	13.8±1.1	31.8±1.1	13.9±1.1	13.9±1.8	13.3±1.2	13.9

Table 25

ANTHROPOMETRIC MEASUREMENTS OF PRE-SCHOOL CHILDREN
FAT FOLD AT TRICEPS : mm (mean ± S. D.)

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All Regions
			Boys				
1 —1½	—	6.4±1.5	6.8±1.6	—	—	5.9±1.6	6.4
1½—2	—	6.6±1.4	6.8±1.3	—	—	6.2±1.7	6.5
2 —2½	—	6.9±1.6	7.0±1.7	—	—	6.4±1.9	6.8
2½—3	—	7.0±1.5	7.3±2.4	—	—	6.6±1.8	7.0
3 —4	—	7.1±1.5	7.6±1.6	—	—	7.2±1.9	7.3
4 —5	—	6.6±1.4	7.3±1.7	—	—	7.2±1.8	7.0
			Girls				
1 —1½	—	6.7±1.5	6.9±1.8	—	—	5.7±1.7	6.4
1½—2	—	6.5±1.7	7.2±1.8	—	—	6.3±1.9	6.7
2 —2½	—	6.6±1.5	3.7±1.9	—	—	6.5±1.8	6.8
2½—3	—	7.1±1.6	7.1±1.5	—	—	7.0±1.7	7.1
3 —4	—	7.2±1.5	8.0±1.7	—	—	7.4±1.9	7.5
4 —5	—	6.8±1.4	8.0±1.8	—	—	7.4±1.9	7.4

Table 26

ANTHROPOMETRIC MEASUREMENTS OF PRE-SCHOOL CHILDREN
CALF CIRCUMFERENCE : Cms (Mean ± S. D.)

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All Regions
				Boys			
1 —1½	14.9±1.3	15.4±1.7	15.1±1.5	14.7±1.7	15.0±1.9	14.8±1.6	15.0
1½—2	15.9±1.0	16.0±1.6	15.4±1.9	15.1±1.9	15.1±1.8	15.5±2.1	15.5
2 —2½	15.7±1.8	16.5±1.6	16.1±4.8	16.3±3.8	16.1±1.3	16.1±1.9	16.1
2½—3	16.7±1.2	17.5±1.6	15.5±4.0	16.9±1.7	16.4±1.4	16.4±1.2	16.6
3 —4	17.8±1.5	17.9±1.6	17.4±1.3	17.5±1.7	17.1±2.3	17.3±1.4	17.5
4 —5	19.7±1.8	18.5±1.5	18.3±1.3	18.6±1.3	18.0±1.7	18.2±1.5	18.6
				Girls			
1 —1½	14.8±1.5	15.0±2.0	14.7±1.4	14.0±1.7	14.7±1.4	14.4±1.7	14.6
1½—2	15.1±1.5	15.6±1.8	15.1±1.5	15.1±2.0	15.3±1.7	15.0±1.4	15.2
2 —2½	16.6±1.7	15.9±1.8	15.8±1.0	15.7±1.7	15.3±3.1	15.8±1.6	15.9
2½—3	17.6±1.5	16.8±1.7	15.9±1.8	16.5±1.5	16.3±1.8	16.3±1.4	16.6
3 —4	17.5±1.3	17.7±1.1	17.0±1.3	17.2±3.1	16.6±3.4	17.2±1.4	17.2
4 —5	18.5±2.0	18.4±1.4	18.0±1.2	18.2±1.4	17.8±1.7	18.0±1.4	18.2

Table 27

ANTHROPOMETRIC MEASUREMENTS OF PRE-SCHOOL CHILDREN
FAT FOLD AT CALF : mm (Mean ± S. D.)

Age : Years	Bombay	Calcutta	Hyderabad	New Delhi	Poona	Vellore	All regions
			Boys				
1 —1½	—	9.6±2.0	10.1±2.0	—	—	9.6±1.9	9.8
1½—2	—	9.5±1.6	10.1±1.9	—	—	9.5±2.0	9.7
2 —2½	—	9.5±1.8	10.1±2.0	—	—	9.5±2.2	9.7
2½—3	—	9.7±1.7	9.4±3.2	—	—	9.3±2.1	9.5
3 —4	—	9.4±1.7	9.8±2.0	—	—	9.4±1.9	9.5
4 —5	—	8.5±1.7	9.1±1.8	—	—	8.9±2.0	8.8
			Girls				
1 —1½	—	9.3±1.0	9.8±2.3	—	—	9.1±2.0	9.4
1½—2	—	9.4±1.9	10.1±2.0	—	—	9.2±2.0	9.6
2 —2½	—	9.6±1.6	10.0±2.2	—	—	9.7±2.2	9.8
2½—3	—	9.7±1.6	9.6±1.8	—	—	9.4±1.9	9.6
3 —4	—	9.5±1.6	9.9±1.9	—	—	9.4±1.9	9.6
4 —5	—	8.7±1.6	9.2±1.8	—	—	9.4±2.0	9.1

7.6. Skin fat fold over Calf and Triceps

These measurements were taken only in children studied at Hyderabad, Calcutta and Vellore, and are in close agreement in all three regions. Fat fold at triceps was about 30% lower than the standard.

7.7. General

There were no significant differences in the anthropometric measurements of children of different regions. The boys tended to be heavier and taller as compared to girls at all age groups. With regard to body circumferences also, the boys had slightly higher values than girls of the same ages. However, the fat-fold thickness tended to be more in case of girls than boys. Though the fat-fold thickness was much less than the standard, there was no fall in the fat-fold thickness with increasing age as has been reported for Western children. All the measurements (except fat-folds which tended to be static) increased with age in both the sexes.

All the body measurements of Indian children, when compared with American standards, were low. The deficit was most for body weight and least for head circumference. Deficit in arm circumference, fat fold thickness, chest circumference and height fell in between in that order. Further detailed analysis of weights of children in rural Hyderabad area showed that when classified according to deficit in weight for age, 14.0% had grade I malnutrition (weight deficit of 10-25%), 65.0% had grade II malnutrition (weight deficit of 25-40%) and 18.0% had grade III malnutrition (weight deficit 40% and more).

8. Comments

This comprehensive country-wide survey carried out on 18,356 pre-school children of six different regions of India has revealed the widespread prevalence of malnutrition among the pre-school population both in rural and urban communities of India. The major nutritional problems encountered were protein-calorie malnutrition, hypovitaminosis A, anaemia and deficiency of the B-complex vitamins. As is to be expected, there were regional variations in the incidence figures.

8.1. While the prevalence of advanced states of protein-calorie malnutrition like kwashiorkor and marasmus is in itself high, this should be considered as a gross under-estimation of the real extent of the problem of protein-calorie malnutrition. Judged by the incidence of signs like moon face and associated hair changes, for every child with the severe form, there appeared to be at least 5 or 6 children with the milder manifestations. Judged by the criterion of growth retardation, the incidence of mild and moderate forms of PCM was indeed very high.

8.2. Ocular manifestations of vitamin A deficiency and oral lesions of vitamin B-complex deficiency were frequently seen and their incidence increased with increasing age. The increase in the prevalence of Bitot's spots in children beyond the age of 3 years was mostly due to stopping of breast feeding, since even small amounts of breast milk provided some preformed vitamin A, which was totally missing in the diets of older children. Increased requirement with increasing body weight with age may be an additional factor.

8.3. Results of anthropometric measurements pointed to the high prevalence of varying degrees of growth retardation. While many of the measurements were found to be between 80 and 90% of the American standard, the body weight was markedly lower, being only 60 to 70% of the standard.

8.4. Examination of the diets of the children indicated that contrary to early belief, the diets provided adequate amounts of protein, even after allowances were made for the poor biological quality of the vegetable protein. The protein intake met the allowances recommended by the ICMR whether considered on the basis of unit body weight or in absolute amounts for the day. While the protein intake was apparently adequate, the intake of calories seemed to be considerably deficient. The actual intake ranged from 600 calories in 1-2 year old children to 900 calories for the 4-5 years old group. Expressed in terms of unit body weight, these ranged from 79 to 73 calories per kg. there being a deficit of nearly 27% in the older age groups.

8.5. This deficiency of calories would seem to be of great public health significance because protein intakes, which otherwise would have been adequate or marginally adequate, become inadequate in the face of this calorie inadequancy, as protein would be utilised for purposes of providing energy. These observations may, therefore, be

interpreted as indicating that protein deficiency in our pre-school children is conditioned to a considerable extent by low intake of calories and that the primary bottleneck in the current dietaries of poor Indian children is not protein, but calories. Appreciation of this fact has an important bearing on the approach towards the control and prevention of PCM. Attempts at control of protein calorie malnutrition in children have, so far, been directed towards the development of supplementary foods with high content of protein (as high as 25%, based on the assumption that protein was limiting in the diets of these children). Since the results of the survey have clearly shown that the immediate need is for more calories, it is obvious that the primary bottleneck to be removed is that of inadequate calorie intake. The simplest and quickest practical approach would thus be to provide the children with increased quantities of the same diets which are now being consumed by them. Making up the calorie deficit by protein-rich foods would appear to be a wasteful way of providing calories. On the other hand, providing empty calories may precipitate protein deficiency, since such a measure may promote growth thus raising protein requirement. The dietaries of these children are also deficient in vitamins and minerals. While the consumption of larger amounts of the diet they are now consuming will relieve the calorie inadequancy, they will not overcome the vitamin and mineral inadequacies in the diets.

8.6. In planning measures to prevent malnutrition among pre-school children, many factors have to be cosidered: availability of the right type of food in adequate amounts, purchasing power of the families and a minimal level of knowledge regarding the special needs of children. It is obvious that these steps can only be undertaken on a long term basis.

8.7. As a short term immediate measure, some specialised services directed towards the pre-school children appear to be necessary to improve their nutritional status. Supplementary feeding programmes appear to be relevant in this context. Some of the important aspects of such supplementary feeding programmes would be the ingredients that go into the preparation of the supplement, nutritional content of the supplement, the delivery system and an evaluation of the programme.

8.8. Among other environmental factors, which are known to influence nutritional status, are infections and infestations. To obtain optimal results, nutrition services should, therefore, be integrated with general medical and health services. Such a programme would also provide opportunities for medical and para-medical personnel to play an important role in nutrition services to the community.

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ANNEXURE I

PRE-SCHOOL CHILDREN EXAMINATION RECORD

I General Information

1.1. Name of the place/Balwadi — No.

1.2. Block/District — Date :

1.3. Name of the child — Age :

1.4. Name of the parents with address — Sex :

1.5. Family members

Adults		Children (under 12 years)	
M	F	M	F

1.6. Occupation of the father/guardian — Total :

1.7. Feeding Habits :

Breastfed ... Yes/No.

Supplements ... Yes/No.

1.8. Income/head/month — Remarks

II. Anthropometry

2.1. Height : Cms.

2.2. Weight : Kg.

2.3. Sitting height : Cms.

2.4. Head circumference : Cms.

2.5. Chest circumference : Cms.

2.6. Arm circumference : Cms

2.7. Calf circumference : Cms.

2.8. Fat fold at triceps : mm.

2.9 Fat fold at calf : mm.

III. Clinical Examination

HAIR

3.1. Sparse

3.2. Discoloured

3.3. Easily plucked

FACE

4.1. Moonface

4.2. Nasolabial dyssebacea

EYES

5.1. Conjunctival xerosis

5.2. Bitot spots

5.3. Corneal xerosis and Keratomalacia

5.4. Corneal opacity

5.5. Night blindness

5.6. Photophobia

LIPS

6.1. Angular stomatitis

6.2. Cheilosis

TONGUE

7.1. Red and Raw

7.2. Papillage-atorphic

7.3. Papilae-Hypertrophic

TEETH AND DENTITION

5 4 3 3 1	1 2 3 4 5
5 4 3 2 1	1 2 3 4 5

8.1. Calories

8.2. Mottled enamel

GUMS

9.1. Spongy, Bleeding

GLANDS

10.1. Parotid enlargement (bilateral, painless)

SKIN

11.1. Follicular hyperkeratosis

11.2. Mosaic dermatosis

11.3. Pellagrous dermatosis

11.4. Crazy pavement dermatosis (C. P. D.)

11.5. Petbechiae and ecchymoses

Pigmentation : Knuckles

Fingers

Toes

NAILS

12.1. Koilonychia

SUBCUTANEOUS TISSUE

13.1. Oedema

13.2. Marasmus

MUSCULO-SKELETAL SYSTEM

14.1. Epiphyseal enlargement

14.2. Beading of ribs

14.3. Craniotabes

14.4. Frontal and Parietal bossing

14.5. Knock-knee and bow-legs

14.6. Harrison's sulcus

14.7. Pigeon chest

GASTRO-INTESTINAL SYSTEM

15.1. Enlargement of liver (Hard)

(Firm)

(Soft)

15.2. Enlargement of spleen

OTHERS

IV. Laboratory Investigations

Blood *Haemoglobin*

X-RAY OF THE WRIST

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ANNEXURE II

DIET SURVEY TO ASSESS THE INTAKE IN PRE-SCHOOL CHILDREN

Date

Name of the family :

Name of the village :

Father :

Occupation :

Mother :

Income :

Child :

Members of the family :

Age of the Child :

Age	Males	Females
Years		
1—3		
3—5		
5—7		
7—9		
9—12		
12—21		
Adults		
Total :		

Food Item	Frequency	Approximate quantity
I. Rice		
Wheat		
Jowar		
Maize		
Ragi		

Food Item	Frequency	Approximate quantity
II. 'Tuar' Dhal		
'Channa' Dhal		
'Moong' Dhal		
'Urad' Dhal		
'Masoor' Dhal		
III. Meat		
Fish (Dry)		
Prawns		
Crabs		
Eggs		
IV. Milk		
Curds		
Butter		
Butter milk		
Ghee & Oil		

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ANNEXURE III

Technique of taking anthropometric measurements

1. Height or Crown-heel length : The subject is made to stand erect on level ground or a platform, with heels together and arms hanging. The occiput, shoulders, buttocks and heels should be in same plane and perpendicular to the ground. The head should be so held that the eyes are directed on the horizon. The anthropometer rod is held either in front or back of the subject ensuring that it is perfectly vertical and parallel to the mid-sagittal plane. The cross-arm of the instrument is gently brought to touch the vortex.

In case of younger children (upto 3 years) a specially prepared wooden measuring board with a sliding cross-piece is used. The child is made to lie on the board with head touching the fixed upright end of the board. The sliding cross-piece is brought to touch the heel.

2. Sitting height or crown - rump length : This measurement is taken with the subject sitting on a table well back, so that the table edge practically touches the backs of the dangling legs. The spine is straightened and the head is so held that eyes are on the horizon. The anthropometer rod is used as described.

In case of younger children (upto 3 years) the same wooden board, as described above, is used. The child is made to lie on the board with head touching the fixed upright end of the board, and the lower limbs held perpendicular to the surface so that the sliding piece touches the gluteal region.

3. Weight : A portable lever-balance is used. The child is weighed with minimum garment and weight is recorded in Kilograms.

4. Head circumference : A flexible steel tape is used. One end of the tape is put on the glabella and the tape is wound round the head passing it over the opisthocranion point and again meeting at glabella point. The measurement is recorded in centimeters.

5. Chest circumference : Using the flexible steel-tape the mean girth of the thorax at expiration and inspiration is measured at the level of the nipples.

6. Arm circumference : It is measured on the left arm at a point mid-way between internal margin of the acromean process of the scapula and the tip of the elbow. The tape should be applied lightly so as to avoid deforming the contour of the skin.

7. Calf circumference : It is measured with a steel tape at the left leg where the circumference is maximum. Tape should be applied gently so as to avoid deforming the contour of the skin.

8. Fat-fold at triceps : The fold is located on the dorsum of the left upper arm at a level mid-way between the lateral margin of the acromean process of the scapula and the tip of the elbow. The level is located with the arm flexed at 90°. Harpenden's calliper is used for taking this measurement. In making the skin fold measurement, the arm should hang freely and the crest of the skin-fold should be parallel to the long axis of the arm.

9. Fat-fold at calf : The fold is made on the back of the leg and parallel to the long axis of the leg where the circumference of the calf is maximum. Harpenden's calliper is used for taking the measurement.

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ANNEXURE IV

Haemoglobin estimation by Cyanmethemoglobin method

Estimation of haemoglobin by this method has been recommended by the Xth International Haematology Congress and World Health Organization Expert Committee on Nutritional Anaemias. This method measures not only oxyhaemoglobin, but also carbon-monoxide haemoglobin. With filter type photoelectric calorimeters, the single relatively broad band of cynamethaemoglobin in the green spectral region has a distinct advantage. The method can be modified to determine haemoglobin in dry blood on filter paper also.

Procedure :

(1) Exactly 5ml of Drabkin's diluent solution are measured into a dry test tube, from a buret or pipette with a suction bulb.

(2) Exactly 0.02ml of blood from standardized heamoglobin pipette is transferred into the diluent solution. Usual care in filling and cleaning of loaded haemoglobin pipette must be exercised.

(3) The pipette is rinsed three times with diluent solution, without allowing the formation of air bubbles in the solution.

(4) The blood is mixed thoroughly with diluent by rotating the tube.

(5) A period of 20 minutes is permitted for the cyanmetheamoglobin to form.

(6) 5 ml of diluent solution are used to get the blank reading.

(7) With green filter No. 540 tube, the readings are taken on photo-electric colorimeter setting blank at 0.

Calibration procedure

(1) The total blood iron is determined by Wong's method. This determination would give absolute amount of haemoglobin.

(2) Exactly 0.02ml of this known blood sample are measured out as described above into 5.0, 7.5 10.0, 12.5, and 15.0 ml respectively of diluent solution and mixed by rotating the tubes. These solutions are now equivalent to blood samples containing respectively 100, 67, 50, 40 and 30% that of the original solution.

(3) Per cent transmission using green filter 540 against diluent as blank set at 0, are read.

(4) A standard graph using these haemoglobin concentration and corresponding transmission is prepared.

Reagents : Drabkin's diluent solution

Sodium Bicarbonate	1 gm
Potassium cyanide	0.05 gm
Potassium ferricyanide	0.20 gm
Distilled water to make	1000 ml

This solution must be preserved in dark brown bottle and preferably kept under cold storage. Its preparation and handling should be done with great care. This solution should not be used after a precipitate has formed at the bottom of storage bottle.

Reference : Diagnostic Laboratory Hematology—G.E. Cartwright (1958) P. 34 and 36.

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